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A monthly publication of the Office of Water Research and Technology,
U.S. Department of the Interior

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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several services of the Office of Water Research and Technology. The cumlative SWRA file from 1968 and monthy updates are available also in magnetic tape through lease from NTIS.

THE OFFICE OF WATER RESEARCH AND TECHNOLOGY DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Office of Water Research and Technology
U.S. Department of the Interior
Washington, D.C. 20240

CONTENTS

SUBJECT FIELDS AND GROUPS

Please use the edge index on the back cover to locate Subject Fields and Indexes.

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions.

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1A. Properties

APPLICATIONS OF STRIPPING ANALYSIS TO METAL DETERMINATIONS IN NATURAL WATERS,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
J. E. Bonelli.
PhD Dissertation, 1980. 187 p 4 Fig, 4 Tab, 182 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX80-28725.

Descriptors: *Metal *Analytical techniques, *Electrochemistry, Water, Freshwater, Zinc, Cadmium, Lead, Copper, Thallium, Water analysis, Stripping analysis.

Analytical methods for the simultaneous multielement determination of zinc, cadmium, lead, and copper, and for the determination of thallium in natural waters are presented. The methods were optimized for their specific intended applications, evaluated, and applied to ultratrace metals determinations in a variety of natural water samples. Interference effects due to intermetallic compound formation, variations in acidity, and unresolved oxidation processes were evaluated and minimized. A positive interference on copper determinations due to iron was identified and characterized. A simple, experimental compensation technique for this latter interference effect was devised and applied to copper determinations in a river water sample. Experimental results indicate that anodic stripping determinations can be performed in a thiocyanage supporting electrolyte medium. Although the gallium electrode was found to be of limited utility for trace analysis by anodic stripping voltammetry, its unique characteristics may lead to other electrochemical applications. (Sinha-OEIS)
W82-01670

NON-EQUILIBRIUM WATER/ROCK INTERACTIONS,
Stanford Univ., CA. Dept. of Geology.
W. E. Dibble, Jr.
PhD Dissertation, 1980. 179 p, 17 Fig, 9 Tab, 118 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-24643.

Descriptors: *Crystal growth, *Mass transfer, Interfaces, Silicates, Chemical reactions, *Mass transport, *Mineral water reactions.

The results of established crystal growth theory and silicate dissolution experiments are combined in developing a new model for mineral/water reactions controlled by surface processes. The overall reaction rate at steady-state is determined by coupling equations for the velocities of mass transport and interface detachment processes. Non-steady state processes can be successfully treated when interface reactions control the rate. For most sparingly soluble minerals, diffusion through the solution can be neglected as a rate-determining factor. Experimental rate data for quartz dissolution are used to define molecular activation mechanisms based on the kink-site detachment model. The quartz dissolution mechanism involves binding of ionic species to surface detachment sites. Surface binding reactions are controlled mainly by the sign and magnitude of the surface electrostatic potential. The dissolution of silicates is more complex than quartz dissolution because most silicates dissolve incongruently. To determine variations in interface composition as a result of incongruent dissolution, values of the chemical potentials of components in the bulk solid phase must be known. The results are used to predict chemical potential values for F- and Li-bearing components and for components in the exchange position of smectites. They show that small amounts of fluorine in a sheet silicate significantly affect the Gibbs energy of formation. (Sinha-OEIS)
W82-01684

1B. Aqueous Solutions and Suspensions

THE SPREADING OF THIN LIQUID FILMS ON A WATER-AIR INTERFACE,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
M. Foda, and R. G. Cox.
Journal of Fluid Mechanics, Vol 101, No 1, p 33-51, November, 1980. 8 Fig, 1 Tab, 17 Ref.

Descriptors: *Films, *Oil-water interfaces, *Physical properties, Thin films, Monomolecular films, Water-air interfaces, Surface tension, Fate of pollutants, Oil pollution, Fluid mechanics.

The spreading of liquid layers on the surface of an immiscible supporting liquid (example, an oil slick on a water body) occurs according to three basic mechanisms: first, gravity opposed by inertia; then, gravity opposed by viscous drag; and finally, after a very long time, when the layer is almost molecularly thin, surface tension, replacing gravity. The paper produces a similarity solution for unidirectional spreading in the third stage, when surface tension is the driving force. The monolayer is considered to be spreading on a quiescent water surface, such as in a long channel. Assumptions are that: (1) the monolayer spreads in a positive direction so that the length is a function of time, (2) the monolayer thickness does not vary, and (3) oil must be continually supplied to the monolayer. The solution gives both the size of the film as a function of time and the velocity and thickness distribution along the spreading film. Experiments with spreading of silicone fluid on distilled water at rest in a channel (120 x 9 x 5 cm deep) produced good agreement with the theory. (Cassar-FRC)
W82-01955

THE CONTAINMENT OF AN OIL SLICK BY A BOOM PLACED ACROSS A UNIFORM STREAM,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
N. D. Di Pietro, and R. G. Cox.
Journal of Fluid Mechanics, Vol 96, No 3, p 613-640, February, 1980. 9 Fig, 1 Tab, 25 Ref.

Descriptors: *Films, *Oil-water interfaces, *Surface tension, Physical properties, Fluid mechanics, Thin films, Monomolecular films, Water-air interfaces, Oil pollution.

In a spreading oil slick a surface tension region exists between the gravity-viscous and monolayer regions. Pressure differences across the oil-water and oil-air interfaces are important in this region, usually only a few mm wide. The surface tension region is important because it is necessary to connect the solution with the gravity-viscous and monolayer regions, and the slopes of the interfaces are largest here. This idea is used to find the theoretical thickness profile of an oil layer contained upstream of an oil boom placed across a channel in which water is flowing at a constant velocity. The total length of the spreading layer and its thickness at the barrier are found as functions of velocity and volume. It is assumed that: (1) the velocity difference across the oil layer is small compared with the water velocity, (2) the monolayer and bulk layer lengths are much larger than the capillary length scale, (3) the interfaces have small slopes, (4) inertia effects in oil and the pressure variations in substrate flow are neglected, (5) the boundary layer in the water is laminar, and (6) the monolayer is not depleted. General conditions for validity of results are discussed. Modifications are given for the case where the boundary layer in the substrate is turbulent. Experimental results from studies on unsteady spreading on quiescent water in a channel agreed well with theory. (Cassar-FRC)
W82-01956

2. WATER CYCLE

2A. General

CAN WE MODEL THE RAINFALL-RUNOFF PROCESS TODAY,
Eidgenoessische Technische Hochschule, Zurich (Switzerland), Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
F. Naef.
Hydrological Sciences Bulletin, Vol 26, No 3, p 281-289, September, 1981. 4 Fig, 4 Tab, 6 Ref.

Descriptors: *Model studies, *Rainfall-runoff relationships, Runoff, Rainfall, Mathematical studies, Simulation.

This paper attempts to illustrate how some of the widely used models for simulating rainfall-runoff processes in a basin are able to operate with data which can be collected with reasonable effort and expense. Models available for such tasks include simple ones such as the unit hydrograph, Nash cascade, runoff coefficient and linear regression; mathematical models which are models with a simple structure but which employ sophisticated methods for parameter or error estimation such as CLS; conceptual models such as Stanford and Sacramento; and physically based models which are based on the solution of differential equations for evapotranspiration, infiltration and runoff. Models of different complexity were calibrated to three small basins with dense networks of recording rain gauges and reliable stream gauges. Under average conditions it was found that the simulation and forecasting of discharge were not difficult tasks. They could be successfully solved using simple concepts. Furthermore, the selection of the model was not critical to the result. However, forecasts made under extraordinary conditions or extrapolations using the models tested appeared to be practically a matter of luck. None of them truly reflected the runoff process, and the data were not available in the required quality. (Baker-FRC)
W82-01609

KINEMATIC FLOW APPROXIMATION OF RUNOFF ON A PLANE: AN EXACT ANALYTICAL SOLUTION,
Griffith Univ., Brisbane, Queensland (Australia). School of Australian Environmental Studies.
J. Y. Parlange, C. W. Rose, and G. Sander.
Journal of Hydrology, Vol 52, No 1-2, p 171-176, June, 1981. 1 Fig, 8 Ref.

Descriptors: *Overland flow, *Model studies, *Rainfall-runoff relationships, *Excess rainfall, *Watershed management, Flow patterns, Mathematical equations, Mathematical studies, Storm runoff, Surface runoff, Laminar flow, Sheet erosion, Soil erosion, *Plane flow, Irrigation effects, Erosion control.

An analytical solution is offered for the estimation of kinematic flow for an excess rainfall runoff. The solution operates on any arbitrary function of time and generalizes a previously proposed model for situations of constant excess rainfalls over a finite period of time. The problem of overland flow was solved by the method of characteristics using a system of mathematical equations. The solution was applied successfully to calculate the runoff resulting from a variable rate of excess rainfall, and also to a problem in border irrigation. The model reproduces the results of an earlier qualitative solution which dealt with the rise and drop of the water level and the progressive reduction of the region where the sheet has a constant thickness. (Geiger-FRC)
W82-01617

PARAMETER ESTIMATION OF RAINFALL-RUNOFF MODELS WITH HETEROSCEDASTIC STREAMFLOW ERRORS--THE NONINFORMATIVE DATA CASE,
Case Western Reserve Univ., Cleveland, OH. Dept. of Systems Engineering.
S. Sorooshian.

Journal of Hydrology, Vol 52, No 1/2, p 127-138, June, 1981. 1 Fig, 1 Tab, 12 Ref. OWRT-C-90320-G(9442)(1).

Descriptors: *Rainfall-runoff relationships, *Model studies, Runoff, Precipitation, Stochastic hydrology, Hydrology, Streamflow.

Due to practical difficulties encountered in obtaining adequate weight estimates, the use of the weighted least-squares criterion for parameter estimation of rainfall-runoff models has been restricted. An estimation procedure is presented which is able to correct the effect of heteroscedastic (changing variance) streamflow errors. The noninformative data case is assumed, and for that a Bayesian formulation is used to automatically estimate the proper weights. Subsequently, the weights are used in the maximum likelihood estimator to evaluate the model parameters. A four-parameter model was used to test the new method, and comparisons were made with the simple least squares criterion and with the weighted objective function of the HEC-1 of the US Army Corps of Engineers, using synthetic data. The study indicated that the need for specifying subjective weighting functions or guessing the values of the weights was totally eliminated. Sensitivity analysis revealed that the resulting response surface of the MLE criterion where the search for model parameters takes place was smoother and more concentric. The improved concentricity of the parameter space helped the search algorithm and increased the chances for convergence to a parameter set which was closer to the true set. The study also suggested that special care is needed in selecting weighting functions. If the selected weighting rule does not explain to some degree the stochastic properties of the errors, then the resulting parameter estimates may produce wrong forecasts. The implementation of the new procedure was easy. (Baker-FRC)
W82-01657

A MODEL OF THE ANTARCTIC SINK FOR STRATOSPHERIC WATER VAPOR,
Iowa State Univ., Ames.
A. R. Douglass.
PhD Dissertation, 1980. 137 p, 24 Fig, 14 Tab, 65 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-06007.

Descriptors: *Water balance, *Water vapor, *Antarctic, Model studies, Exchange processes.

The main focus of the work is the development of a model through which the sink mechanism can be quantified and understood in the context of the rest of the annual water vapor budget. The classical description of the stratospheric water vapor distribution is discussed and other proposed sources of stratospheric water vapor and their implications for the annual budget are considered. Observational evidence that led to the proposal of the Antarctic sink mechanism is also presented. The upper limit of the amount of water vapor removed from the stratosphere in 1973 is slightly larger than the lower limit of estimates of the amount of water vapor added to the stratosphere by oxidation of methane. If no other sources are operational, and the methane source strength were shown to be the low estimate, the Antarctic sink would allow balance to be achieved in the annual budget. Even so, it would be difficult to explain the observed water vapor distribution if this high altitude source were to be balanced only by a south polar sink. At least in the northern hemisphere, where there is no winter stratospheric sink, the lack of a pronounced vertical and poleward gradient of water vapor mixing ratio remains a puzzle, especially if the methane source is at the upper limit of the estimates. Although any circulation proposed for the stratosphere must not contradict the observations of stratospheric water vapor, it is with caution that the water vapor may be used as a tracer of troposphere to stratosphere exchange processes. (Sinha-OEIS)
W82-01686

ANALYSIS OF THE ORIGIN OF WATER WHICH FORMS LARGE AUFEIS FIELDS ON THE ARCTIC SLOPE OF ALASKA USING GROUND AND LANDSAT DATA,
Maryland Univ., College Park.
For primary bibliographic entry see Field 2C.
W82-01690

GEOCHEMISTRY AND HYDRODYNAMICS IN THE HUTT AND LEEMAN EVAPORITIC LAGOONS, WESTERN AUSTRALIA: A COMPARATIVE STUDY,
Uranerz Australia Party, Ltd., Subiaco.
For primary bibliographic entry see Field 2L.
W82-01746

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1972,
Science and Education Administration, Beltsville, MD. Water Data Lab.
Science and Education Administration, Miscellaneous Publication Number 1412, September 1981. 437 p, 98 Fig, 630 Tab, 75 Ref. J. B. Burford, J. L. Delashmutt, and R. T. Roberts, compilers.

Descriptors: *Agricultural watersheds, *Hydrologic data, *Precipitaion, Rainfall-runoff relationships, Experimental basins, Steamflow, Steam discharge.

Selected hydrologic data from 131 watersheds for 1972 are reported including data on monthly precipitation and runoff for all the watersheds; annual maximum discharge and maximum volumes of runoff for intervals of 1, 2, 6, and 12 hours and 1, 2, and 8 days for 117 watersheds; daily precipitation for 130 watersheds; mean daily discharge for 131 watersheds; daily maximum and minimum air temperature for 18 watersheds; and detailed information on one or more selected typical storm events for 98 watersheds. Information on selected storm events includes: tabular data for antecedent rainfall and runoff; data on rainfall intensity and runoff for the event and on accumulated depth of rainfall and runoff; description of watershed conditions at the time of the selected events; and plottings of runoff hydrograms and rainfall histograms. For newly established watersheds, descriptions of watershed physical characteristics, instrumentation, land management and recommended area of application of the results are given. There are 19 waterhseds installed in recent years and not previously reported. (Moore-SRC)
W82-01772

A MATHEMATICAL MODEL OF THE HYDROLOGIC REGIME OF THE UPPER NILE BASIN,
Snowy Mountains Engineering Corp., Cooma (Australia).
J. A. H. Brown, F. M. J. Ribeny, E. J. Wolanski, and G. P. Codner.
Journal of Hydrology, Vol 51, No 1-4, p 97-107, May, 1981. 4 Fig, 1 Tab, 4 Ref.

Descriptors: *Mathematical models, *Hydrological regime, *Nile Basin, Catchment basins, Basins, River basins, Africa, Channel flow, Lakes, Systems engineering, Computer programs.

The Upper Nile Basin Model was developed as part of the Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga, and Mobutyu Sese Seko (Albert), sponsored by the United Nations Development Program. The hydrology of the basin is dominated by the role of the lakes, which cover about 20% of the total surface area. The model comprises three separate models combined into an overall system, which is the Upper Nile Basin Model. A catchment model enables the runoff of the catchments contributing to the three lakes to be estimated from rainfall and evapotranspiration data. A lake model computes outflows and changes in storage for various inflows and operational rules. A channel model is used to predict the movement of water in the main river channels between the lakes. The Upper Nile Basin Model includes a total of 36 programs and a master program which controls their selection. The 36 programs can be called up automatically in any predetermined sequence. Beginning with only rainfall and evaporation data, the model is capable of simulating the behavior of the whole basin and of computing the outflows from the system downstream of Lake Mobutu Sese Seko. Provisions for preselection of programs for a particular study, inclusion of new programs, and easy replacement or revision of individual existing programs contribute to the flexibility of the model. (Carroll-FRC)
W82-01857

AN AQUIFER SIMULATION PROGRAM FOR MICRO-BASED PROCESSORS,
Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
For primary bibliographic entry see Field 2F.
W82-01879

DEVELOPMENT AND APPLICATIONS OF A RUNOFF MODEL FOR SNOWCOVERED AND GLACIERIZED BASINS,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
For primary bibliographic entry see Field 2C.
W82-01885

SPATIAL SIMULATION OF SNOW PROCESSES,
Danish Inst. of Applied Hydraulics, Hoersholm.
For primary bibliographic entry see Field 2C.
W82-01887

MODELING STORMWATER STORAGE/TREATMENT TRANSIENTS: THEORY,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
M. A. Medina, Jr., W. C. Huber, and J. P. Heaney.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 781-797, August, 1981.

Descriptors: *Mathematical models, *Storm runoff, Storm water, Urban runoff, *Wastewater treatment, Simulation models, Water quality, Computers, Prediction, Water pollution, Storage requirements, Mathematical equations.

Preliminary planning and assessment of storm water storage and treatment needs and facilities is increasingly based on long-term characterization of the rainfall/runoff process rather than on selection of a particular design storm event. This characterization is achieved either by a deterministic approximation using continuous simulation models or through probabilistic analysis of storm event loads and storage/treatment device performance. This report discusses the development of a deterministic approach in which mathematical models are derived from the principle of conservation of mass to represent the movement, decay, storage, and treatment of storm water runoff pollutants and dry weather wastewater flows through natural and engineered transport systems. These mathematical models describe the transient response of storage/treatment systems to highly variable forcing functions of flow and concentration both for completely mixed systems of constant and variable volumes and for one-dimensional advective-dispersive systems. (Carroll-FRC)
W82-01980

2B. Precipitation

A STOCHASTIC CLUSTER MODEL OF DAILY RAINFALL SEQUENCES,
Purdue Univ., Lafayette, IN. School of Civil Engineering.
M. L. Kavvas, and J. W. Delleur.
Water Resources Research, Vol 17, No 4, p 1151-1160, August, 1981. 3 Fig, 3 Tab, 34 Ref. OWRT-B-036-IND(20).

Descriptors: *Rainfall, *Stochastic process, Model studies, Cluster models, Neyman-Scott model, Precipitation, *Indiana, Weather patterns.

The Neyman-Scott cluster process was applied to a two-level point stochastic model for rainfall

events at a given station in the time dimension. The primary level is rainfall-generating mechanisms; the secondary level, the rainfalls generated by the mechanisms. The cluster model assumes superposition of rainfalls (that the rainfall events occur in clusters and that the occurrence of rainfall events in a certain time interval is caused both by the given mechanism in the time interval and also by generating mechanisms which occurred before the interval). The model was tested with rainfall data from six stations in Indiana. Since the cluster model is time homogeneous, it may be of practical use only for stationary rainfall occurrences. (Cassar-FRC)
W82-01651

VARIOUS KINETIC ENERGY CHARACTERISTICS OF HAILPATTERNS IN THE GROSSVERSUCH IV EXPERIMENT,
Groupement National d'Etudes des Fleaux Atmospheriques, Grenoble (France).
J. F. Mezeix, and N. Doras.
Journal of Applied Meteorology, Vol 20, No 4, p 377-386, April, 1981. 10 Fig, 4 Tab, 21 Ref.

Descriptors: *Hail, *Kinetic energy, Kinetics, Precipitation, Sleet, Storms, Weather modification, Experimental data, Switzerland.

The Grossversuch hailpad network of hailfalls was used to record distinct hailpatterns and calculate their kinetic energy. Hailpad data was collected from 184 distinct non-seeded hailpatterns, so that possible characteristics of kinetic energy of hailpatterns might be grasped. It was noted from the four years of recorded data from 1975 through 1978 that the four year multi-annual distribution of global energy may be considered as lognormal, represented by a probability density function. The annual lognormal distributions, however, have statistically different means. Relations were established between global kinetic energy and several physical parameters of hailpatterns. Viewed from the kinetic energy aspect, the hail phenomenon seems to be organized. The regularity of the evolution of the physical characteristics of hailfalls may suggest an hypothesis of a hail production mechanism similar from one hailfall to another. Where kinetic energy is concerned, the result stays within the continuum for all the hailfalls. Some of the properties common to hailfalls will probably aid in the identification of physical effects in storm modification experiments. (Baker-FRC)
W82-01732

EVALUATION OF A PRECIPITATION MAP USING A SMOOTHED ELEVATION-PRECIPITATION RELATIONSHIP AND OPTIMAL ESTIMATES (KRIGING),
Service Hydrologique National, Bern (Switzerland).
F. A. deMontmollin, R. J. Olivier, R. G. Simard, and F. Zwahlen.
Nordic Hydrology, Vol 11, No 3/4, p 113-120, 1980. 4 Fig, 9 Ref.

Descriptors: *Precipitation, *Kriging, *Altitude, *Maps, *Switzerland, Mountains, Anomaly maps, Rain gages.

An annual average precipitation map for a mountainous 1600 sq km area between Neuchatel and Lausanne, Switzerland, was evaluated by the anomaly method, improved by using an optimal smoothed altitude index and universal kriging. Data from 45 rain gaging stations for the years 1974-76 were used. Altitude data was obtained from a data bank containing all the digitized altitudes for the western part of Switzerland on a 50-mile grid. A near optimal filtering window of 7 km was chosen. The average altitude over an area of optimized size was designated the index elevation. The precipitation range was 720-1200 mm, the higher amounts being found in the southern slope of the Jura Mountains and Jorat hills and the dry region in the center. (Cassar-FRC)
W82-01892

PHOTOMETRIC INVESTIGATIONS OF PRECIPITABLE WATER AND OPTICAL DEPTH WAVELENGTH EXPONENTS IN AN URBAN AREA,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
T. Yoksas.
Journal of Applied Meteorology, Vol 19, No 5, p 616-622, May, 1980. 4 Fig, 20 Ref.

Descriptors: *Aerosols, *Atmospheric water, *Water vapor, Urban areas, *Precipitation, Wavelengths, Data collections, Optical properties, *Photometry, St Louis, Missouri, METROMEX.

Aerosol loading and atmospheric precipitable water were monitored in the St. Louis urban area during Project METROMEX 1976. Data were collected with a six-channel Volz sunphotometer. A least-square fit of photometric observations to spatially and temporally proximate radiosonde measured precipitable water vapor produced the exponent (1/1.993) in the precipitable water equation. This indicates agreement with the square-root absorption law of band models. Wavelength exponents calculated from least-square fits of five water vapor transmission band optical depths to wavelengths were represented by a wavelength exponent of 1.71 + or - 0.54 using 70 observations. Modal values of the wavelength exponent were centered at 1.60 and 1.90. Trends in daily evolution of the wavelength exponent indicate the growth and decay of corresponding Junge-type power law aerosol size distributions similar to those measured in situ during previous studies in the same area. (Cassar-FRC)
W82-01966

OBSERVATIONS OF TWO COLORADO THUNDERSTORMS BY MEANS OF A ZENITH-POINTING DOPPLER RADAR,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
L. J. Battan.
Journal of Applied Meteorology, Vol 19, No 5, p 580-592, May, 1980. 7 Fig, 20 Ref.

Descriptors: *Thunderstorms, *Radar, Storms, Colorado, Arizona, Velocity, Wind velocity, Hail, Precipitation, Remote sensing.

A pulsed-Doppler radar, operated with its antenna pointed toward the zenith, was used to obtain data on the distributions of radar reflectivity, mean Doppler velocity, velocity, vertical air velocity, and Doppler-velocity variance in two thunderstorms over eastern Colorado. Data were collected at height intervals centered 152 meters apart. Previous studies have shown that many thunderstorms include a series of turbulent updraft cores spaced at distances of 1 to 3 kilometers, each of which is surrounded by sinking or slowly rising air. The cores are each composed of a current of rising air which includes a number of eddies having diameters of a few hundred meters to 1 or 2 kilometers. The two thunderstorms observed during the course of this study demonstrated some of the characteristics generally attributed to multicell thunderstorms, but the cell sizes were smaller and more frequent than previously reported. Hailstorms in southeastern Arizona also exhibited a series of turbulent updraft cores. On the basis of similarities between the thunderstorms observed in Colorado and those observed elsewhere, it is suggested that the variable nature of the radar reflectivities and updrafts may be a characteristic feature of most thunderstorms and that they may contribute significantly to the highly variable nature of hail. (Carroll-FRC)
W82-01967

WATER-ICE AND WATER-UPDRAFT RELATIONSHIPS NEAR -10 DEGREES C WITHIN POPULATIONS OF FLORIDA CUMULI,
National Hurricane and Experimental Meteorology Lab., Coral Gables, FL.
R. I. Sax, and V. W. Keller.
Journal of Applied Meteorology, Vol 19, No 5, p 505-514, May, 1980. 7 Fig, 1 Tab, 5 Ref.

Descriptors: *Cloud physics, *Crystallization, Rain, Clouds, Ice, Temperature effects, *Convective precipitation, *Florida.

During most late spring and summer afternoons, south Florida experiences a large population of cloud towers in various stages of development, with tops near the -10 C level. Penetration of several of these convective towers near their tops in the temperature range of -4 C to -12 C with aircraft specifically equipped to obtain cloud physics data resulted in the collection of an in-cloud microphysical data set which demonstrated a sequential development of cloud water, rainwater, graupel, and crytalline ice as the cloud ages. Repeat penetrations of some convection towers showed that some, but not all, experienced a very rapid onset of graupel. A separate data set showed a large scatter in the relationship between maximum value of cloud water and maximum value of vertical velocity, suggesting that measurements of cloud water, by themselves, can be misleading as an indication of cloud growth activity. The sequential pass data showing the evolution of ice and water are consistent with a rime-splintering, secondary ice production hypothesis. The variability in the decay of the cloud water mass observed from one cloud to another appears to be related to the detailed structure of the updraft and to the manner in which mixing of drier ambient air is occurring near the top of the cloud envelope. Three case studies are used to demonstrate the variabilities encountered in the evolutionary sequence of the four parameters. (Carroll-FRC)
W82-01968

ANOMALIES IN TEMPERATURE AND RAINFALL DURING WARM ARCTIC SEASONS AS A GUIDE TO THE FORMULATION OF CLIMATE SCENARIOS,
J. Williams.
Climatic Change, Vol 2, No 3, p 249-266, 1980. 9 Fig, 3 Tab, 16 Ref.

Descriptors: *Weather patterns, *Arctic, *Precipitation, Climatology, Atmospheric pressure, Air temperature, Seasonal variation, Air circulation.

Temperature, precipitation, and pressure anomalies in the northern hemisphere were investigated for the Arctic's 10 warmest winters (mean temperature -13.5 C) and 10 warmest summers (mean temperature 10.5 C) during the last 70 years. Means for the remaining years were -15.8 C in winter and 9.5 C in summer. This study was undertaken to secure information applicable to the problem of global warming from increased CO2 in the atmosphere. During warm periods in the Arctic, circulation changes produce anomalies elsewhere in the Northern Hemisphere, with some areas cooling and some warming. Warm winters produce larger amplitude anomalies than warm summers. In warm winters the sea level pressure field differs from the long-term mean in several regions, specifically Greenland-North Atlantic, while warm summers produce no such differences. Warm summers are associated with large coherent areas of increasing or decreasing mean precipitation in the Northern Hemisphere, as a result of circulation changes, while warm winters have no significant effect on precipitation. During warm Arctic summers, Alaska and the west coast of the U.S. are drier; the southern states and Florida, wetter. Positive differences in precipitation at several North American stations were as follows (in mm): Jacksonville, 103; Charleston, 103; New Orleans, 103; Yuma, 14; Sandusky, 54; Prince George, 57; Masset, 55. Negative differences (in mm) were found at: Topeka, -82; Peoria, -83; Des Moines, -74; Crete, -96; Lincoln, -106; Valentine, -47; Huron, -50; and Prince Albert, -42. (Cassar-FRC)
W82-01975

SIMPLIFIED METHOD FOR RAINFALL INTENSITIES,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
G. H. Hargreaves.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 281-288, September, 1981. 1 Tab, 8 Ref.

Descriptors: *Precipitation, *Rainfall intensity, *Developing countries, Rainfall distribution, Weather data collections.

Several rainfall amount-intensity relationships were investigated with particular focus on providing rainfall intensity data for developing countries, where such data is inadequate for water resources development projects. Methods evaluated were regressions predicting maximum monthly rainfall from mean monthly rainfall, 10-year return period, 24-hour duration amounts from maximum monthly rainfall, and the full range of rainfall intensity-duration-frequencies from the 10-year 24-hour values. Data from Central America, the U.S., India, Australia, and, to a more limited extent, the world were used. Maximum monthly precipitation and outlying and evelope values can be reliably estimated from mean monthly rainfall. There is a fairly good relationship between 10-year, 24-hour rainfall and maximum monthly rainfall. For durations of 30 min to 4 days and return periods of 5 to 100 years, precipitation amounts vary approximately as the fourth root of the time and the sixth root of the return period. Errors may result from not compensating for anomalous storms, short records, inadequate station coverage, and nonrepresentative locations. Further statistical analysis of the equations in this paper is recommended to determine the extent of their application on a global scale. (Cassar-FRC)
W82-01978

NOTE ON RANDOM RAINDROPS AND SAMPLING ERROR,
Otago Univ. (New Zealand).
W. E. Bardsley.
Nordic Hydrology, Vol 11, No 1, p 1-6, 1980. 1 Tab, 4 Ref.

Descriptors: *Sampling, *Errors, *Rain gages, Mathematical studies, Precipitation, *Rainfall, Radar, Statistics.

Rain gage measurements and radar reflectivity of a given volume of air containing raindrops are among the variables of interest in precipitation studies which can be interpreted as series of random numbers of random variables. Some statistical results obtained by Robbins (1948) were used to obtain a general expression for the coefficient of variation of such variables when the number of terms per sum and the transformed variables follow any specified probability distribution. Some simple expressions are obtained for the special case of an exponential distribution of raindrop diameters. Some conclusions of Gertzman and Atlas (1977) were obtained as special cases of the general expression. (Cassar-FRC)
W82-02032

TOWARDS AN UNDERSTANDING OF THE EFFECTS OF OROGRAPHY ON THE DISTRIBUTION OF PRECIPITATION OVER THE CAPE PENINSULA,
Washington Univ., Seattle. Dept. of Atmospheric Sciences.
D. A. Erasmus.
South African Journal of Science, Vol 77, No 7, p 295-298, July, 1981. 5 Fig, 6 Ref.

Descriptors: *Orographic precipitation, *Precipitation intensity, *Cape Peninsula, Precipitation, Climates, Air circulation, Vortices, Flow, *South Africa.

The precipitation distribution in the vicinity of Table Mountain in the Cape Peninsula, South Africa, was investigated for five rainfall periods during the winter of 1977. For each of these periods, precipitation was associated with the passage of eastward moving baroclinic disturbances. An important factor was a strong flow of warm moist air at low levels to maintain the liquid water content of the feeder clouds. Seeding particles were generated at intermediate altitudes, which augmented rainfall and resulted in the downward displacement of the precipitation maximum. A vorticity was observed which may result in localized increases in rainfall. The vorticity may be the result of the confluence of fast moving air streams in the lee of the col between Table Mountain and Devil's Peak. A more comprehensive data network is needed to further understand precipitation in the area. (Small-FRC)
W82-02085

2C. Snow, Ice, and Frost

ANALYSIS OF THE ORIGIN OF WATER WHICH FORMS LARGE AUFEIS FIELDS ON THE ARCTIC SLOPE OF ALASKA USING GROUND AND LANDSAT DATA,
Maryland Univ., College Park.
D. K. Hall.
PhD Dissertation, 1980. 141 p, 18 Fig, 16 Tab, 53 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-03882.

Descriptors: *Water sources, *Meteorological data, *Groundwater, Arctic, Melt water, *Alaska, Surface-groundwater relations, *Aufeis fields, River ice.

The origin of the water which forms large aufeis fields (overflow river ice) on the Arctic Slope of Alaska has been controversial. For this study, various hypotheses were tested using ground and satellite data to analyze the origin of the aufeis water. In addition, meteorological data from 1972 through 1979 were analyzed and graphically displayed with aufeis extent. It is concluded that aufeis extent in a given river channel on the Arctic Slope is controlled by discharge from reservoirs of groundwater. It seems probable that precipitation passes into limestone aquifers in the Brooks Range, through an interconnecting system of subterranean fracturs in calcareous rocks and ultimately discharges into alluvial sediments on the coastal plain to form aufeis. It is speculated that only small (perhaps beaded) aufeis patches are affected by local meteorological conditions of the months just prior to aufeis formation. (Sinha-OEIS)
W82-01690

ON THE VALUES AND VARIABILITY OF DEGREE-DAY MELTING FACTOR IN FINLAND,
Finnish Hydrological Office, Helsinki.
E. Kuusisto.
Nordic Hydrology, Vol 11, No 5, p 235-242, 1980. 4 Fig, 2 Tab, 4 Ref.

Descriptors: *Snowmelt, *Degree-day factor, *Heat transfer, Solar radiation, Forests, Precipitation, Seasonal variation, Snow depth, Snow density, *Finland.

The degree-day factor, widely used in snowmelt forecasting, was studied using data collected from 12 stake stations, each with 25 stakes in forest and 9 on open field. During 1959-1978 about 96,000 snow depth and 17,000 snow density measurements were obtained. The water equivalent of snow was calculated on the basis of the average of snow depth and density. The annual maximum water equivalent ranged between 80 and 180 mm at different stations in southern and central Finland, and between 120 and 250 mm in northern Finland. The seasonal averages of degree-day factor varied widely from station to station. For forest sites the mean was 2.42 mm per degree C per day (range 1.75-3.36 mm per degree C per day) and for open sites, 3.51 mm per degree C per day (range 2.82-4.94 mm per degree C per day). A 10% increase in canopy cover in forest sites decreased the degree-day factor by about 0.16 mm per degree C per day. On rainy pentades the average degree-day factors (in mm per degree C per day) were 2.16, 2.33, and 2.79 for forest and 3.21, 3.33, and 3.38 for open field in the precipitation classes 0-1, 1-10, and > 10 mm, respectively, contrary to expectations that greater solar radiation on clear days could lead to higher degree-day factors. The degree-day factor varied seasonally. In Finland in March it was 30-70% of the seasonal mean, which was reached during early April in the south and late April in the north. There was a greater increase in open field than in forest. (Cassar-FRC)
W82-01735

SUMMER ICE AND CARBON DIOXIDE,
Lamont-Doherty Geological Observatory, Palisades, NY.
G. Kukla, and J. Gavin.
Science, Vol 214, No 4520, p 497-503, October 30, 1981. 4 Fig, 3 Tab, 62 Ref.

Descriptors: *Ice, *Carbon dioxide, Temperature effects, Seasonal variation, Antarctic, Polar regions, Model studies.

Changes occurring in the surface air temperature of the earth and in the areas of snow and sea ice are reviewed. Data have been collected from satellite monitoring systems, from ship reports, from the Oceanographic Atlas of the Polar Seas, and from various published ice charts. The information gathered yielded several conclusions. The multiyear variability in the extent of the Antarctic sea ice is considerable and has a large potential impact on the energy budget of the middle and high southern latitudes. In the late spring and summer ice around Antarctica during the last few years has been less extensive than reported in atlases published prior to 1970. Pack ice in specific areas appears to have been more extensive from November through February in the 1930's than it is at present. The observations agree qualitatively with the expected effect of a carbon dioxide increase. The mean surface air temperatures along selected northern latitudes during spring and summer were higher in 1974 to 1978 than in 1934 to 1938. The positive anomalies appear to be associated with the seasonally shifting belt of melting snow. This finding is consistent with the temporal and spatial impact of increasing carbon dioxide predicted by the energy balance model. It is concluded that studies of highly variable components of the climate system such as snow and pack ice fields and associated surface air temperatures should be given priority in the search for early signs of a carbon dioxide effect. Conclusions about a relationship of the observed changes in snow and sea ice areas and surface air temperatures to carbon dioxide increases are only tentative. (Baker-FRC)
W82-01843

GLACIER SURVEYS IN ALBERTA - 1979,
National Water Research Inst., Burlington, (Ontario). Water Resources Branch.
I. A. Reid, and J. O. G. Charbonneau.
Report Series No 69, 1981. 18 p, 6 Fig, 20 Tab, 9 Ref.

Descriptors: *Glaciers, *Athabasca glacier, *Saskatchewan glacier, Surveys, Surface water, Runoff, Linear change, Volumetric change, Stereoscopic terrestrial photographs, *Alberta, *Melt water, Streamflow, *Glaciohydrology.

Glaciers act as natural regulators, storing water in winter and releasing it in summer. To gain some understanding of this phenomenon and the contribution which glaciers make to streamflow, the predecessors of the Water Survey of Canada began glacier surveys in 1945. The earlier surveys offered some clue to the role of the glacier, but the data collected were not sufficient to provide the overall picture. Following adoption of photogrammetric survey techniques, however, the glacier surveys have evolved to the extent that it is now feasible to produce a series of maps from which the linear, areal, directional and volumetric changes can be determined. The surveys have revealed that the glaciers, in general, are becoming smaller in size; hence the regulating effect on streamflow is diminishing. (WATDOC)
W82-01855

DEVELOPMENT AND APPLICATIONS OF A RUNOFF MODEL FOR SNOWCOVERED AND GLACIERIZED BASINS,
Technical Univ. of Denmark, Lyngby. Inst. of Hydrodynamics and Hydraulic Engineering.
L. Gottlieb.
Nordic Hydrology, Vol 11, No 5, p 255-272, 1980. 9 Fig, 2 Tab.

Descriptors: *Glaciers, *Snowmelt, *Runoff, Glaciohydrology, *Model studies, Ice cover, Peyto Glacier, Alberta, Johan Dahl Land Glacier, Greenland, *Runoff forecasting.

A model for prediction of daily runoff from snow-covered and glacial basins was developed and applied to two basins. The model divides the basin into an ice-free area and an ice-covered area, accounting for the large differences in heat balance,

runoff, meteorological conditions, and snow cover between the two types of areas. The heat exchage between atmosphere and snow or ice cover is calculated by a modified degree-day approach or, if the data are available, by the complete energy balance equation. The NAM model, a conceptual, lumped rainfall-runoff model, is used to calculate the amount of water routed to the stream each day. In the ice-covered area, runoff originates from the melting of seasonal snow cover and from melting of the permanent ice mass. The model treats the routing of melt water over the ice as a simple linear reservoir. The model was tested on the Peyto Glacier Basin, Alberta, for which 8 years of runoff data and meteorological observations were available. Overall agreement was quite good, but the model did not predict major peak flows accurately. The model was also used for the study of the Johan Dahl Land glacierized basin, Greenland, of interest in hydropower development. Here, 15 years of synthetic runoff were generated from 4 years of discharge data (1976-79). Estimates of average runoff were greatly improved; the standard deviation obtained using the 15 years generated data plus 4 years actual observations was half that of the standard deviation using only 4 years of observed runoff. (Cassar-FRC)
W82-01885

SPATIAL SIMULATION OF SNOW PROCESSES,
Danish Inst. of Applied Hydraulics, Hoersholm.
A. G. Thomsen.
Nordic Hydrology, Vol 11, No 5, p 273-284, 1980. 10 Fig, 1 Tab, 4 Ref.

Descriptors: *Snowmelt, *Snow accumulation, *Satellite technology, Simulation analysis, Model studies, Watersheds, Hydrographs, Streamflow, Forest management, Remote sensing.

A system of simulation models designed to efficiently use both traditional and remotely sensed data sources is presented. Watershed information on topography, vegetation, and soils in digital terrain models serve as a data base for watershed analysis, classification of snow in Landsat imagery, and automatic generation of parameter decks for operating distributed simulation models of snow cover dynamics and streamflow generation. The system is tested in the Williams Fork Watershed in the Central Rocky Mountains of Colorado, area 476 sq km, elevation 2380 to 4137 meters. The models can be used individually or in combination. EXTRACT automatically defines hydrologic response units and calculate their parameters from data in overlays. WATBAL is a snow process simulation model requiring daily extreme temperatures and precipitation as driving variables. LATFLOW simulates overland flow and baseflow contributions to the snowmelt hydrograph and the dominant lateral flow component. Using EXTRACT it is also possible to simulate watershed response to thinning or clear cutting timber stands. SNOWPCT is available for classifying the fractional snow covered area within Landsat pixels (ground resolution elements). (Cassar-FRC)
W82-01887

EVAPORATION FROM A SNOW COVER--REVIEW AND DISCUSSION OF MEASUREMENTS,
Lulea Univ. (Sweden). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 2D.
W82-01888

LIMITATIONS IN HYDROLOGICAL INTERPRETATIONS OF THE SNOW COVERAGE,
Federal Inst. for Snow and Avalanche Research, Davos/Weissfluhjoch (Switzerland).
J. Martinec.
Nordic Hydrology, Vol 11, No 5, p 209-220, 1980. 10 Fig, 2 Tab, 7 Ref.

Descriptors: *Snow cover, *Runoff, *Snowmelt, Seasonal variation, Alpine regions, Dischma Basin, *Switzerland.

Although patterns of receding snow cover in a given area are similar from year to year, they cannot be used to reliably predict the volume of stored snow or water and seasonal runoff. The Dischma basin, Switzerland, had similar snow cover (about 40-45%) on July 5, 1974, and June 8, 1976, but the measured runoffs for 150 degree days from the starting date were 14.2 million cu meters and 6.4 million cu meters, respectively. Similar snow cover in June 21, 1972, and July 17, 1978, produced 9.6 million cu meters and 12.8 cu meters, respectively. The areal extent of the snow cover appears to be related to the ratio of the current water equivalent to its maximum value in the respective year. (Cassar-FRC)
W82-01889

2D. Evaporation and Transpiration

WATER REQUIREMENTS AND MAN-INDUCED CLIMATE CHANGE,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
G. H. Hargreaves.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 247-255, September, 1981. 9 Ref.

Descriptors: Evapotranspiration, *Water requirements, *Climatology, *Agriculture, Research priorities, *Carbon dioxide, Water management, Temperature, Air temperature, Crop production, *Global climate change.

The global temperature rise expected over the next 50 years as a result of increased concentrations of CO_2 in the atmosphere from fossil fuel burning will affect water requirements. Doubling of CO_2 concentrations would increase temperatures by 2 C near the equator and 8 C at 83 degrees latitude. This temperature rise would shift crop zones 250-300 miles further north and increase photosynthesis. Total increases in water requirements, considering increases due to higher temperature and increases in length of growing season, are 16% at 30 degrees latitude, 27% at 40 degrees, 42% at 50 degrees, and 63% at 60 degrees. At the same time, rainfall in the 37-47 degree latitudes, where the major portion of U.S. corn and livestock is produced, is expected to decrease. However, potential benefits (increased crop production) may result from higher global temperatures if water is available in sufficient quantities at the required locations. (Cassar-FRC)
W82-01633

ENVIRONMENTAL AND PHYSIOLOGICAL CONTROL OF WATER FLUX THROUGH PINUS CONTORTA,
Colorado State Univ., Fort Collins. Dept. of Forest and Wood Sciences.
S. W. Running.
Canadian Journal of Forest Research, Vol 10, No 1, p 82-91, March, 1980. 8 Fig, 2 Tab, 31 Ref.

Descriptors: *Trees, *Stomatal transpiration, *Soil-water-plant relationships, Leaves, Water potential, Pine trees, Air temperature, Temperature, Humidity, Conductance, Evapotranspiration, Forests, Experimental forest, *Colorado.

Humidity responses studied in a stand of Pinus contorta Dougl. ex Loud lodgepole pine in the Fraser Experimental Forest, Colorado, were similar to those reported for other conifers. The following measurements were recorded during June-August 1978: leaf conductance, leaf water potential, temperature, humidity, and radiation. The daily range of leaf conductances decreased 10-fold from June (0.12-0.16 cm per sec) to August (0.01-0.03 cm per sec). There was a high correlation between predawn leaf water potential and morning maximum leaf conductance. There was not enough difference in stomatal response in needles of different ages to permit formal analysis. Generally, older needles appeared unable to close their stomata as tightly as new needles, and maximum leaf conductance was slightly lower and more erratic in the oldest needles. Low atmospheric humidity significantly decreased midday leaf conductance. Minimum leaf water potential threshold was -1.8 to -2.0 MPa. The seasonal change in total soil-water-plant resistance to water flux was nonlinearly correlated with changes in predawn leaf water potential, which is an indirect measure of soil water potential. (Cassar-FRC)
W82-01827

EVAPORATION FROM A SNOW COVER--REVIEW AND DISCUSSION OF MEASUREMENTS,
Lulea Univ. (Sweden). Div. of Water Resources Engineering.
L. Bengtsson.
Nordic Hydrology, Vol 11, No 5, p 221-234, 1980. 9 Fig, 1 Tab, 19 Ref.

Descriptors: *Snow cover, *Evaporation, Condensation, Heat transfer, Snowmelt, Seasonal variation, Air temperature, Lysimeters, *Sweden.

A review of the literature and lysimeter measurements in Sweden demonstrated that total evaporation from snow cover during the season was only 10-20 mm. The calculated net total evaporation, accounting for the energy supply, for a single day in April was 0.14 mm. Variation in evaporation over the day, April 6, 1978, at Lulea, was from -5 mm per hour to 10 mm per hour. During midwinter when air was dry, little evaporation occurred. In spring solar radiation was available but the vapor pressure difference was very small. In the beginning of May 1979 evaporation rates were 0.6-0.8 mm per day, decreasing to zero by May 14 and becoming negative (condensation) May 15-23. Total evaporation was 6 mm, but net evaporation only 3 mm. The aerodynamic formula is most frequently used for determining evaporation on a routine basis, but should be used together with energy balance computations, because evaporation rate is limited by available energy. The profile method, which compensates for the effect of density stratification in the air, can be used on a short-term basis. (Cassar-FRC)
W82-01888

WAYS OF SUCCESSIVE REFINEMENT OF METHODS OF CALCULATING THE DUTY OF WATER,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
A. I. Budagovskii, and L. Ya. Dzhogan.
Water Resources (English Translation), Vol 7, No 6, p 483-500, November-December, 1980. 4 Fig, 27 Ref. Translated from Vodnye Resursy, No 6, p 29-51, November-December, 1980.

Descriptors: *Irrigation efficiency, *Evaporation, *Consumptive use, Evapotranspiration, Water use efficiency, Soil water, Mathematical studies.

Methods for the calculation of the nonreturnable consumption of water for irrigation were refined. Existing methods for making this calculation are at least 20-25 years old. The new refinement replaces the biological curve of evaporation and considers soil evaporation as a function of its water content. The effect of precipitation on soil water evaporation is also considered. One of the most important steps is determining the extent of nonproductive evaporation. The heat-water balance method of calculating evaporation is also refined. The assumption of equality of the critical water content for transpiration and evaporation by bare soil was eliminated. (Small-FRC)
W82-02094

2E. Streamflow and Runoff

LOG PEARSON III DISTRIBUTION - EFFECT OF DEPENDENCE, DISTRIBUTION PARAMETERS AND SAMPLE SIZE ON PEAK ANNUAL FLOOD ESTIMATES,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol 52, No 1-2, p 149-159, June, 1981. 5 Fig, 3 Tab, 8 Ref.

Descriptors: *Flood peak, *Mathematical studies, *Flood forecasting, Markov process, Statistical

methods, Analysis of variance, Correlation analysis, Flood plain management, Flood control, Flood profiles.

The effect of sample size, distribution parameters and dependence on peak annual flood estimates by the log Pearson III distribution was examined in 172 Australian streams. Overall results showed that positive skewness flood estimates were underestimated, while those for negative skewness were overestimated. The percentage difference (d) decreased with increasing sample size. However, in streams with great variability and skewness, errors of over 40% may be expected. Analyses of distribution parameters showed that the mean did not affect d. The difference was at a minimum when skewness was between -0.5 and 0. The lag-1 autocorrelation had little effect on d-values. Based on 30 years of data, the 100-year peak flood estimate for Australian streams is in error by about 10% using the log Pearson III distribution. For individual streams, errors as high as 50% could occur. (Geiger-FRC)
W82-01649

LOG PEARSON III DISTRIBUTION - AN EMPIRICALLY-DERIVED PLOTTING POSITION,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
R. Srikanthan, and T. A. McMahon.
Journal of Hydrology, Vol 52, No 1-2, p 161-163, June, 1981. 1 Tab, 5 Ref.

Descriptors: *Mathematical studies, *Monte Carlo method, *Flood frequency, Flood peak, Flood forecasting, Statistical methods, Flood control, Flood profiles, Graphical analysis, Graphical methods, Comparison studies.

The log Pearson Type III (LP-III) distribution has been adopted as the standard distribution for flood frequency analysis in several countries; however, no appropriate plotting position has been recommended for its use. A Monte Carlo analysis was undertaken to determine an appropriate value for alpha, the constant in the general plotting position formula used in the LP-III distribution. The optimum value of alpha was found to vary with the shape of the distribution or g, the coefficient of skewness of the logarithms of the peak annual discharges. The optimum value of alpha over all values of g was close to 0.4. This value was in agreement with previous studies on the optimum value of the constant used in the general plotting position formula of the LP-III distribution. (Geiger-FRC)
W82-01650

LEGAL CHALLENGE OF THE UNGAGED WATERSHED,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
D. F. Kibler, J. M. Hrubovack, and D. C. Froehlich.
Water Resources Bulletin, Vol 17, No 3, p 458-465, June, 1981. 1 Fig, 5 Tab, 17 Ref. OWRT-A-049-PA(4), 14-34-0001-8040.

Descriptors: *Flood peak, *Judicial decisions, *Culverts, Flood frequency, Watersheds, *Runoff forecasting, *Pennsylvania, Legal aspects, Gaging, Hydrographs, Flood plain zoning, Design floods, Hydrologic aspects.

Methods for estimating flood peak discharges in ungaged Pennsylvania watersheds were compared in connection with a court case in which the design of highway culverts carrying the Wissahickon Creek near Lansdale, Pennsylvania, was contested by a landowner in the basin. The Environmental Hearing Board ruled in favor of the defendants on August 25, 1976, and further appeals did not produce any change in the decision. Methods used by the plaintiff and the resulting 050 were as follows: Soil Conservation Service Composite Hydrograph, 2922 and 2120 cfs; and Regional Science Research Institute (Hammer, 1974) method, 1933 cfs. Methods used by the defendants and resulting Q50 were: Potter, 744 cfs; PSU III, 1366 cfs; Department of Environmental Resources B curve, 1390 cfs; Soil Conservation Service Flood Peak, 1140, 1440, and 1940 cfs. Six methods applicable to ungaged Pennsylvania watersheds were evaluated on 38 years' data from the Little Mahoning Creek and the Aquashicola Creek. Standard errors resulting from application of these methods to a total of 10 gaged stations were as follows: Federal Highway Administration method, 63.6%; United States Army of Engineers, 41.5%; Department of Environmental Resources, 26.5%; U. S. Geological Survey methods, 47.2%; Pennsylvania Department of Transportation Flood Peak Frequency Design Manual (PSU III) 38.9%; and Pennsylvania Flood Index Map, 31.5%. Those methods developed from a large number of stations within the study region performed better. Generally, methods that depend on mapping of point values, such as the C-index, were better than either regression models or iso-line contours. (Cassar-FRC)
W82-01664

PREDICTING STORM RUNOFF FROM SMALL GRASSLAND WATERSHEDS WITH THE USDAHL HYDROLOGIC MODEL,
Oklahoma State Univ., Stillwater.
R. L. Bengtson.
PhD Thesis, 1980. 187 p, 38 Fig, 68 Tab, 45 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-27163.

Descriptors: *Model studies, *Watersheds, *Storm runoff, Hydrologic data, Grasslands, Calibration, *Oklahoma, *Runoff forecasting, Comparison studies, Hydrologic models, Predictions.

A study of the capabilities of the USDAHL model was conducted on four grassland watersheds located in central Oklahoma. The objectives of this study were: (1) to calibrate the USDAHL model to find those hydrologic parameters which best simulate the observed runoff, (2) to test the transferability of the model by applying it to three watersheds using the preceding hydrologic parameters and comparing the observed runoff against the simulated runoff, and (3) to identify any components of the USDAHL model that require improvements. Based on the analysis and interpretation of the results of this study, the following conclusions were made: (1) The hydrologic parameters to be varied during calibration are the vegetative parameter (A), depression storage (VD), evapotranspiration (ET/EP), and deep groundwater recharge (GR); (2) The Type II calibration procedure proved to be the best procedure for calibrating the USDAHL model; (3) Subsurface flow can be ignored for small watersheds of the type studied with ephemeral runoff; and (4) The model overpredicted annual peak rates of flow when calibrated for runoff yield. (Sinha-OEIS)
W82-01672

INVESTIGATIONS INTO THE DYNAMICS OF WATER MOVEMENT ON A LOW RELIEF LANDSCAPE ON THE EASTERN SHORE OF MARYLAND,
Maryland Univ., College Park.
For primary bibliographic entry see Field 2F.
W82-01673

FLOOD CONTROL ON THE PARANA AND PARAGUAY RIVERS,
Motor-Columbus Consulting Engineers, Inc., Baden (Switzerland).
W. Keller, J. van Duivedijk, and G. Mondada.
International Water Power and Dam Construction, Vol 33, No 7, p 36-43, July, 1981. 7 Fig, 2 Tab.

Descriptors: *Flood control, *Rivers, *Reservoirs, Diversion, Storage, Model studies, Mathematical models, Floods, *Argentina, *Paraguay, Economic aspects, Flood damage, Social impact, Parana River, Paraguay river.

The objectives of flood studies conducted on the Parana and Paraguay Rivers were to obtain an understanding of the extraordinary floods with a return period of 10 to 100 years which have devastating effects on the riverine areas in Argentina and Paraguay; to obtain the same for extreme floods resulting either from natural causes or from the rupture of dams upstream; to determine precisely the hydraulic and economic consequences of these types of floods; and to propose, evaluate and carry out preliminary designs for possible flood-protection works. The study area was influenced by the reach of the Parana river between the mouth of the Iguazu and Baradero in the delta of the Parana river, and the reach of the Paraguay river between Asuncion and its confluence with the Parana river, for a total river length of about 2000 km. Extensive surveys and studies were made in the area to evaluate the economic consequences of the floods. The extent of flooding differed considerable along the river and mainly depended on the topographical situation. To obtain a proper understanding of the inundation phenomena under various flow conditions, a mathematical model of the river system was designed, including the flood plains and adjacent areas which are inundated only during extraordinary floods. One of the possibilities for protection against floods is the temporary storage of flood water in reservoirs. Other plans include the diversion of high discharges through floodways and the local embankments around urban or rural centers. Cost aspects are considered briefly. (Baker-FRC)
W82-01707

LOG PEARSON III DISTRIBUTION - IS IT APPLICABLE TO FLOOD FREQUENCY ANALYSIS OF AUSTRALIAN STREAMS,
Monash Univ., Clayton (Australia). Dept. of Civil Engineering.
T. A. McMahon, and R. Srikanthan.
Journal of Hydrology, Vol 52, No 1/2, p 139-147, June, 1981. 4 Fig, 1 Tab, 8 Ref.

Descriptors: *Flood frequency, Flood forecasting, Forecasting, Floods, Streams, *Australia, *Mathematical studies, Maximum flow, Annual runoff, *Log Pearson distribution.

An analysis was made using moment ratio diagrams of peak annual discharges of 172 Australian streams. The study made use of the log Pearson Type III distribution as it has been adopted for use in flood frequency analysis. To test the acceptability of the LP-III distribution as a general flood frequency distribution for Australian streams, moment ratio values for the peak annual discharge series were plotted. When the study had been completed it was concluded that the log Pearson III distribution could be recommended as a suitable general distribution for flood frequency analysis. The theoretical distributions - normal, 2-parameter log-normal, gamma, Gumbel, Weibull, and exponential - fitted the data poorly. The procedure of setting the coefficient of skewness (g) of the logarithms of peak annual discharges to zero, if the sample value of g is not statistically different from zero, is questioned. It is concluded that, at least for the case where g is greater than zero, this practice is not to be followed, but rather the sample value of g should be used. (Baker-FRC)
W82-01731

LOW-FLOW FREQUENCY AND FLOW DURATION OF TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
R. L. Gold.
Geological Survey Open-File Report 78-807, 1981. 361 p, 7 Fig, 1 Plate, 2 Tab, 20 Ref.

Descriptors: *Low flow, *Flow duration, *Streamflow, *Flow rates, Hydrologic data, Gaging stations, Sites, Drainage area, *Frequency analysis, Streams, Flow characteristics, Regulated flow, Average flow, Discharge measurement, Streamflow forecasting, Maps, *Tennessee.

Low-flow frequency and duration data are presented to define variations of the low flow of Tennessee streams both in time and place. Analysis has been made of 204 continuous record stations, both regulated and unregulated and 651 partial-record stations operated either by the U.S. Geological Survey or Tennessee Valley Authority through the 1975 water year. Flow duration and frequency data have been tabulated for the continuous record sites using the digital computer and graphical

methods. Frequency data only is presented for partial-record sites computed in most cases by comparing several discharge measurements at the site with concurrent daily mean flow for an appropriate gaging station. Flow duration data can be used to define a flow duration curve, with the slope at points on that curve used to establish the dependability of the stream to sustain a particular flow. Low-flow frequency data are presented to predict the probability that a specified flow or lesser flow will recur through time. (USGS)
W82-01779

LOW-FLOW CHARACTERISTICS OF STREAMS IN THE DESCHUTES RIVER BASIN, WASHINGTON,
Geological Survey, Tacoma, WA. Water Resources Div.
J. E. Cummans.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $3.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-639, 1981. 20 p, 4 Fig, 4 Tab, 5 Ref.

Descriptors: *Low flow, *Streamflow, *Streamflow forecasting, *Data collections, Flow rates, Discharge measurements, Correlation analysis, Gaging stations, Precipitation, Fish management, Hydrologic data, *Washington, Deschutes River basin.

The streams in the basin usually have their low flows in August and September. Seven-day low flows were smallest in 1952 when annual rainfall at the Olympia airport was also the least during the 1945-75 period of continuous gaging-station records in the basin. The magnitude and frequency of seven-day low flows were estimated for 23 streamflow sites, either from frequency analysis of data at long-term stations or from correlation of measured or computed discharges at a streamflow site with data at a long-term station. Seven-day low flows ranged from no-flow at one tributary of Deschutes River having a drainage area of 1.85 square miles to 98 cubic feet per second for Deschutes River near its mouth, where the drainage was 162 square miles. Mean monthly flows were determined for two long-term stations and estimated for months of July to September for the other streamflow sites. (USGS)
W82-01781

STAGE-DISCHARGE RELATIONS AT DAMS ON THE ILLINOIS AND DES PLAINES RIVERS IN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
For primary bibliographic entry see Field 4A.
W82-01793

A MATHEMATICAL MODEL OF THE HYDROLOGIC REGIME OF THE UPPER NILE BASIN,
Snowy Mountains Engineering Corp., Cooma (Australia).
For primary bibliographic entry see Field 2A.
W82-01857

STATISTICAL DETERMINATION OF DESIGN LOW FLOWS,
Bechtel, Inc., San Francisco, CA.
A. Prakash.
Journal of Hydrology, Vol 51, No 1-4, p 109-118, May, 1981. 1 Fig, 4 Tab, 6 Ref.

Descriptors: *Statistical methods, *Design flow, *Low flow, Prediction, Flow, Mathematical studies, Probabilistic process, Minimum flow, Streamflow, River low.

In designing non-safety-related and safety-related hydraulic structures for use in the nuclear power industry, it is necessary to ensure that these facilities are able to perform their design functions during the n-year low and the probable minimum flow, respectively. Although probabilistic approaches have been developed to estimate low stream flows of a recurrence interval of n years, no attempt appears to have been made to define the probable minimum flow. Analysis of the low stream flows of 66 streams in the United States has deomonstated that the SMEMAX transformation normalizes the available data for all of the streams and provides reasonable estimates of low flows up to a recurrence interval of 100 years. For higher recurrence intervals, predictions made with SMEMAX are overly conservative. Qualitatively, the probable minimum flow is defined as a hypothetical flow that can be considered to correspond to the least runoff available from existing geomorphic conditions and a critical combination of reasonably possible hydrometeorological factors which are conducive to minimum stream flows. Two statistical approaches can be adopted to obtain a quantitative estimate of the probable minimum flow. The first involves defining the probable minimum flow as the lower boundary parameter in the three-parameter Gumbel's bounded exponential distribution. The second approach involves assigning a low frequency of occurrence to the probable minimum flow, frequently 10 to the minus 7th power. Since the first approach was found to provide an overestimation of the probable minimum flow for seven out of the ten streams analyzed, it is suggested that a variety of appropriate distributions be tried and the one giving the best fit be used for deriving a quantitative estimate of probable minimum flow. (Carroll-FRC)
W82-01858

MODELING STORMWATER STORAGE/TREATMENT TRANSIENTS: APPLICATIONS,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
M. A. Medina, Jr., W. C. Huber, and J. P. Heaney.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 799-816, August, 1981. 18 Fig, 2 Tab, 20 Ref.

Descriptors: *Mathematical models, *Storm runoff, Storm water, Urban runoff, Wastewater treatment, Simulation models, Water quality, Computers, Biological oxygen demand, Prediction, Water pollution, Des Moines, Des Moines River.

Mathematical models derived from a unified concept of pollutant mass transport through the various components of the physical system have been developed to describe the response of storage/treatment systems to highly variable storm water inflows. This methodology has been successfully applied to the actual urban area configuration of Des Moines, Iowa, and its receiving water, the Des Moines River. Continuous simulation was used to examine system behavior in terms of both historical sequence of events and frequency of occurrence of events of various magnitudes. Use of a well-mixed constant volume model to represent a hypothetical urban runoff control facility, combined with increases in the hydraulic detention times while providing secondary treatment to dry weather flow, resulted in predictions of appreciable increases in the frequency of occurrence of events which equaled or exceeded a given dissolved oxygen concentration in the receiving water. Comparison of measured effluent biological oxygen demand mass rates showed that the well-mixed constant volume model closely described the performance of a detention tank in Milwaukee, Wisconsin. The well-mixed storage/treatment models predict an immediate response at the system outfall to variations in storm water volume. Any well-mixed constant volume basin providing a sufficiently long detention for inflows accomplishes concentration equalization by both volumetric mixing and pollutant decay. Although the primary function of variable volume systems is to provide flow equalization, the pollutant peak and mean mass rates from these systems can be effectively decreased by reducing peak and mean outflow rates. (Carroll-FRC)
W82-01981

LEARNING FROM THE SKIPTON FLOOD,
R. B. Russell.
Water, No 30, p 20-22, January, 1980. 6 Fig, 3 Ref.

Descriptors: *Flood forecasting, *Flash floods, *Forecasting, Floods, Warning systems, Flood data, Meteorological data collection, Satellite technology, Hydrologic data, *Great Britain.

The flood which occurred in Skipton, Great Britain, in June 1979 followed a rainstorm with return periods in excess of 500 years. Such storms occur over some urban area in England and Wales on the average of once a year. A total of about 5 hours elapsed between the first appearance of the storm on the record of the radar sited about 170 kilometers away and the cessation of the storm. The flood peak occurred only an hour after the beginning of the intense rainfall in the area and at about the same time as the end of rainfal. Although only a very alert analyst would have deduced from the radar mosaic alone that a potentially dangerous situation was developing prior to the commencement of intense rainfall, a trained forecaster with access to radar and satellite data would have been alert to the development of the possibility for rapid storm growth in the area much earlier. Consultation between trained meteorologists and hydrologists could have provided warning of the flood 1 to 2 hours before the event. Even such a short lead time can result in significant financial savings and avoidance of losses of life, as well as appropriate diversions of traffic and mobilization of relief services. A radar system served by appropriately trained meteorological and hydrological staff and integrated with satellite information provides the best chance for issuing flood warnings in cases such as this. There is also a possibility that surveys could be conducted to identify urban areas potentially at risk from such localized events of extremely long return period. (Carroll-FRC)
W82-02063

THE DAY THAT THE RAIN CAME DOWN,
L. Freeman.
Water, No 31, p 2-4, March, 1980.

Descriptors: *Flood control, *Warning systems, *Flood damage, *Great Britain, Flood protection, Regional floods, Floodproofing, Management planning.

Extensive flooding which resulted from record rainfalls in areas served by the Welsh, Wessex, and South West water authorities in Great Britain provided many lessons for the water industry. A total of more than 125 communities experienced some flooding ranging in degree from 30 to over 100 year return periods. Heavy constant rainfall over a 24-hour period permitted warnings up to 16 hours in advance of the flood event on long and fairly easily predictable rivers, but very short warning periods on other short, sharp, and flashy rivers. In some cases, flood waters were significantly higher than predicted. While the warnings resulted in significant reductions of property losses in many communities, in others people felt a false sense of security resulting from fairly recent construction of flood protection works and failed to take precautionary measures. Lessons provided to the water authorities by these floods included the need for training exercises, especially in areas which experience only infrequent floodings; the need to review the strength of essential private flood protection walls and banks and to determine whether water authorities should take over responsibility for them; the need to make provisions for evacuation of water after the rivers subside, especially in areas where protection works prevent the flow of water back into the river bed; the need to evaluate the security of communications systems; and the need to record flood experiences so that future water authority personnel can benefit from what is learned during such events. The effectiveness of flood alleviation schemes in many communities during this flood event should encourage other communities to proceed with planned flood control measures. (Carroll-FRC)
W82-02064

METHODS OF STUDYING INVERTEBRATE DRIFT IN RIVERS,
Akademiya Nauk SSSR, Petrozavodsk. Karelskii Filial.
For primary bibliographic entry see Field 7A.
W82-02074

HYDROLOGIC AND ANTHROPOGENIC FACTORS AFFECTING WATER QUALITY IN THE RIVERS OF THE UKRAINIAN CARPATHIANS,
Akademiya Nauk URSR, Kiev. Inst. Hydrobiologii.
For primary bibliographic entry see Field 5B.
W82-02076

2F. Groundwater

A GRAPHICAL APPROACH TO PREDICTION OF GROUNDWATER POLLUTANT MOVEMENT,
North Carolina State Univ. at Raleigh. Dept. of Marine Earth, and Atmospheric Sciences.
For primary bibliographic entry see Field 5B.
W82-01634

GROUNDWATER DISCHARGE TO THE PACIFIC OCEAN,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
I. S. Zektser, and R. G. Dzhamalov.
Hydrological Sciences Bulletin, Vol 26, No 3, p 271-279, September, 1981. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Groundwater movement, *Ocean circulation, Pacific Ocean, Inflow, Hydrology, Discharge measurement, Coastal aquifers.

Concepts concerning groundwater outflow to the oceans of the world are presented. A method for evaluating submarine groundwater is discussed, with estimates for discharge to the Pacific Ocean along all its coastline and major islands. Through the analysis of groundwater discharges over a generation of time to the Pacific Ocean it is noted that this global process depends on a complex combination of various natural factors such as climate, topography, geology and hydrogeology. The dynamics of groundwater flow, permeability and storage properties of the unsaturated zone and aquifers, and other factors strongly influence submarine groundwater discharge. In the main, however, groundwater discharge value depends on the structure of inflow and outflow elements of the water balance of drainage basins, which in turn are governed by the ratio of heat and moisture as the main indicator of the natural physiographical zoning. The distribution of values of groundwater discharge to the world ocean on a global scale is therefore subject to latitudinal physiographical zoning. These values gradually increase from subtropic regions to moderate areas, sharply increase in wet subtropics and tropics, and decrease in semiarid and arid regions. Anomalous large or small values of submarine groundwater discharge, associated with the shielding effect of mountains on atmospheric circulation patterns, wide karst development, drainage effects of river valleys, and other factors are confined to local coastal areas and generally are known not to affect the general dependence of groundwater discharge to the ocean on the latitudinal physiographic zoning. (Baker-FRC)
W82-01647

INVESTIGATIONS INTO THE DYNAMICS OF WATER MOVEMENT ON A LOW RELIEF LANDSCAPE ON THE EASTERN SHORE OF MARYLAND,
Maryland Univ., College Park.
M. S. Christy.
PhD Dissertation, 1980. 172 p, 27 Fig, 3 Tab, 87 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-03869.

Descriptors: Groundwater, Runoff, *Soil moisture, Water table, *Storm runoff, Watersheds, Maryland, *Dorchester County, *Groundwater runoff, Coastal aquifers, Tidal flats.

The role of groundwater in storm runoff events and the dynamics of the subsurface watershed were the focal points of this study. The investigations were carried out over a three year period at a study site on a tidewater peninsula in Dorchester County on the Eastern Shore of Maryland. The role of groundwater in runoff was evaluated with a recently developed storm hydrograph separation technique using naturally occurring isotopes as basin wide tracers. Results of the study showed both typical behavior patterns of water movement and patterns that were seemingly unique to a flat landscape. Traditional and modeled evaluations of storm runoff show groundwater to be only a minor contributing factor. Quantitative isotopic analysis showed that in fact there was a major groundwater contribution to the runoff occurring at this study site. A factor of runoff that appears to be unique to landscapes of low relief is the distinct threshold between high storm yield and no storm yield. When both the soil moisture and the watertable are relatively high, there is substantial runoff even from low volume rain events. However, regardless of rainfall volume and/or intensity, when the soil moisture and the height of the watertable are low, there is no apparent runoff. An average watertable depth of 36 cm below the ground surface was the apparent threshold for storm runoff at this site. Above and below this level there was and was not runoff, respectively. (Sinha-OEIS)
W82-01673

NUMERICAL ANALYSIS OF TRANSIENT SALT/FRESH-WATER INTERFACE IN COASTAL AQUIFERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
R. I. Layla.
PhD Dissertation, 1980. 206 p, 24 Fig, 4 Tab, 101 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22411.

Descriptors: *Numerical analysis, *Aquifers, *Saline water intrusion, Interfaces, Coasts, Estuaries, *Coastal aquifers, Saline-freshwater interfaces.

The simultaneous effect of the salt-and the freshwater flow on the areal distribution of the interface in coastal aquifers was studied under transient conditions. A two-dimensional model was developed to simulate the growth or the decay of the interface in confined or unconfined aquifers. The contribution from the capillary region to the interface elevation change was also studied. A numerical model using the Galerkin-finite element method was developed to solve the flow equations describing the flow of fresh and salt waters. The adequacy of the numerical model in predicting the interface elevation was verified by comparing its results with existing physical and steady-state analytical solutions. The numerical model was used to solve various problems pertaining to different flow conditions in order to illustrate the effect of salt-water friction, capillary flow and capillary storage on the transient development of the interface. The results indicate that salt-water flow significantly influences the rate of growth of the interface. The influence of capillary flow on the interface elevation is more pronounced at small initial saturated thickness, while the contribution of the static moisture profile on the capillary storage is greatest at small depths to the water table. (Sinha-OEIS)
W82-01693

COMPONENTS OF SATURATED ZONE THICKNESS IN A NIGERIAN BASEMENT COMPLEX REGOLITH,
Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
Hydrological Sciences Bulletin, Vol 26, No 3, p 291-303, September, 1981. 5 Fig, 2 Tab, 21 Ref.

Descriptors: *Saturation zone, Groundwater hydrology, Saturated soils, Saturated flow, Mathematical studies, *Nigeria, Spatial distribution, *Groundwater, *Geohydrology.

An attempt is reported to obtain an optimum prediction of the gross spatial distribution of the thickness of the zone of saturation in the regolith of a typical deeply weathered Basement Complex area in southwestern Nigeria. The technique employed is a combination of the algebraic polynominal trend surface and conventional regression models. The study attempted to determine the components of saturated zone thickness in the regolith of the study area and identify environmental factors or processes responsible for their presence, and to obtain an optimally determined equation by which depths of the groundwater medium to be penetrated by wells at specific sites within the study area could be predicted ahead of the actual sinking operations with a reasonably high level of confidence. The tentative conclusion drawn from this study applies more to the humid and low relief areas of the Basement Complex. It states that the thickness of the saturated zone in the regolith has a regional trend, increasing from the major river channel to the interfluve. While the regional component follows the general spatial trend of weathering depth, the local component of the gross spatial distribution arises from the irregular contour of the basal surface of weathering and differential rates of regolith removal by fluvial erosional processes. The local component, about 16% of the gross spatial distribution, is adequately described by a conventional regression equation in which the independent variable is weathering depth. This method has several advantages over that of fitting progressively higher-order trend surfaces to spatial data. (Balker-FRC)
W82-01710

THE RELATIONSHIP BETWEEN MACRO-TOPOGRAPHY AND THE GROUNDWATER QUALITY IN THE GREAT FISH RIVER BASIN, EASTERN CAPE PROVINCE,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Geology.
E. A. W. Tordiffe, and B. J. V. Botha.
Water SA, Vol 7, No 3, p 113-138, July, 1981. 21 Fig, 4 Tab, 10 Ref.

Descriptors: *Topography, *Groundwater hydrology, *Impaired water quality, *Geohydrology, Calcium, Sodium, Chlorine, Connate water, *South Africa, Water pollution sources, Chemical properties, Geochemistry, Chemistry of precipitation, Water quality, Great Fish River basin.

The relationship between the geomorphologic region and ground water quality was investigated in the Great Fish River Basin in Eastern Cape Province, South Africa. The area studied is about 25,000 sq km and contains the following geomorphologic regions: the Margin Region, the Great Escarpment, the Headbasin, and the Interior Plateau. A distinct relationship was found between the regions and ground water characteristics. High percentages of Ca(+2) and HCO3(-1) were determined in the higher lying Interior Plateau, and high Na(+1) and Cl(-1) were found in the ground water of the Headbasin and Marginal Region. Groundwater movement is almost stagnant in these last two low lying regions. The differences in quality may be due to the influence of connate marine waters from the sedimentary rocks of the Dwyka Formation and Ecca Group. Atmospheric salts may also be deposited. Meteoric water in the Interior Plateau can dissolve CaCO3, but as this water percolates down toward the lower regions it becomes saturated with Ca(+2) and HCO3(-1). Then the CaCO3 is precipitated as calcrete. (Small-FRC)
W82-01718

GROUNDWATER DISCHARGE THROUGH SPRINGS WITH WELL-DEFINED OUTLETS--A CASE STUDY FROM JELOYA-MOSS, S. NORWAY,
Norges Landbrukshoegskole, Vollebekk. Dept. of Geology.
J. O. Englund, and K. F. Meyer.
Nordic Hydrology, Vol 11, No 3/4, p 145-158, 1980. 5 Fig, 4 Tab, 9 Ref.

Descriptors: *Springs, Artesian wells, Recharge, Groundwater recharge, Wells, Aquifers, Fissure water, *Norway, *Geohydrology, *Geochemistry.

The hydrogeology and chemistry of five springs and an artesian well in the Jeloya-Moss area were investigated for a year starting June 7, 1977, as part of a project concerning groundwater in Norway. All the springs drain fissured-rock aquifers and are of the overtopped, unconfined type. The artesian well drains confined water from a sand and gravel

aquifer below marine clay. Discharges are variable, and can be described by the variability index, or ratio of the lowest yield to the greatest. The well has a discharge of 1944-2736 liters per hour and a variability index of 0.71. The springs' variability indexes range from 0.01 to 0.53. If no discharge occurs, the springs would theoretically dry up within 2 months to 3 years and the well, in 6.5 years. Average residence time of the water in the aquifers ranges from 4.5 days to 180 days in the springs and 301 days in the well. Chemical composition of the water is similar to that of the deep groundwater, 30-100 meters below land surface. However, changes in composition take place as the water moves through the rocks. The longer the residence time, the higher the concentration of dissolved solids. Brackish water in the well is a result of dissolution of fossil sea salts. Most of the protons in precipitation are consumed in the chemical weathering process; only 1-2% of the weathering is caused by precipitation. (Cassar-FRC)
W82-01748

SELECTED DRILL-STEM-TEST DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01774

SELECTED HYDROGEOLOGIC DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01777

HYDROGEOLOGY OF WELL-FIELD AREAS NEAR TAMPA, FLORIDA, PHASE 1--DEVELOPMENT AND DOCUMENTATION OF A TWO-DIMENSIONAL FINITE-DIFFERENCE MODEL FOR SIMULATION OF STEADY-STATE GROUND-WATER FLOW,
Geological Survey, Tallahassee, FL. Water Resources Div.
For primary bibliographic entry see Field 6A.
W82-01780

HYDROGEOLOGY OF THE GATLINBURG AREA, TENNESSEE,
Geological Survey, Nashville, TN. Water Resources Div.
A. Zurawski.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $12.00 in paper copy, $8.00 in microfiche. Geological Survey Open-File Report 79-1167 (WRI), August, 1979. 79 p, 45 Fig, 5 Tab, 12 Ref.

Descriptors: *Geohydrology, *Groundwater availability, *Water supply, *Aquifer characteristics, Test wells, Water yield, Geologic fractures, Water quality, Chemical analysis, Well logs, Water management, Planning, Evaluation, *Tennessee, Gatlinburg.

A study of ground-water availability in the Gatlinburg area, Tenn., was undertaken to improve concepts of ground-water occurrence in the Blue Ridge and demonstrate that ground water is present in sufficient quantities to provide an alternative to surface water as a source of supply. Of 25 test wells, 8 produced between 50 and 116 gallons per minute. The Gatlinburg area, located on the northern flank of the Great Smoky Mountains, is underlain by fractured, variably metamorphosed, sedimentary rocks. The most effective criteria for choosing well sites were valley areas with 7 percent or less land slope, presence of fracture traces, and deep overburden. Mapped faults were not a good indicator of ground-water occurrence. The largest amounts of ground water occur in irregularly shaped zones of deep and intense weathering in the rocks underlying broad, fracture-controlled valleys. Permeable zones along fractures at depths of 170 feet or less supply most of the water. (USGS)
W82-01782

GROUNDWATER LEVELS IN NEBRASKA 1980,
Geological Survey, Lincoln, NE. Water Resources Div.
M. S. Johnson, and D. T. Pederson.
Nebraska Water Survey Paper Number 51, September 1981. 65 p.

Descriptors: *Groundwater, *Wells, *Water level, *Water level fluctuations, Observation wells, Hydrographs, Well data, Aquifer characteristics, Hydrologic data, *Nebraska.

This report summarizes the 1980 water-level changes in Nebraska on a statewide basis and by major areas where significant changes from estimated predevelopment levels have occurred. It describes the availability of data on water levels, provides information on changes in the water-level measurement program during the year, and summarizes data on the two major causes of water-level changes--precipitation and groundwater use. Because of the large amount of available data, much of the information presented in this report is of a generalized nature. The maps showing areas where water levels have risen or declined are an interpretation of point-value data, and some areas may not be precisely delineated. Changes in water levels are illustrated by hydrographs of 89 continuous-record wells for the period of record. (USGS)
W82-01785

RECORDS OF WATER LEVELS IN UNCONSOLIDATED DEPOSITS IN EASTERN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01788

AN AQUIFER SIMULATION PROGRAM FOR MICRO-BASED PROCESSORS,
Osmania Univ., Hyderabad (India). Centre of Exploration Geophysics.
B. H. Briz-Kishore, and R. V. Avadhanulu.
Ground Water, Vol 19, No 4, p 400-406, July/August, 1981. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Computer programs, *Simulation analysis, *Aquifers, Groundwater movement, Pumping tests, Aquifer characteristics, Aquifer systems.

A computer program for simulating an aquifer system was devised for use with a microprocessor. Written in both FORTRAN IV and BASIC languages, the program requires only 10K bytes of memory for the generate code. It can be used to study the aquifer system under steady-state and dynamic conditions with constant flux or no-flux boundaries, conversion from confined to unconfined conditions in both homogeneous and heterogeneous aquifer systems, as well as the effects of evapotranspiration and constant recharge. The effect of pumping on an aquifer is studied for multiple pumping periods, and predictions can be reviewed at various time steps within each pumping period. The program is illustrated using a problem solved by Trescott et al. (1976) on an IBM/370 with a program of 100K bytes length. Results were essentially the same on both computers, with convergence after 45 iteractions on the microprocessor and 34 on the larger computer. (Cassar-FRC)
W82-01879

DRAWDOWNS AT THE FREE WATER TABLE DURING PUMPING TESTS IN ARTESIAN AND SEMIARTESIAN AQUIFERS,
TERRAQUA Aps, Kalundborg (Denmark).
H. Kaergaard.
Nordic Hydrology, Vol 11, No 3/4, p 159-168, 1980. 5 Fig, 13 Ref.

Descriptors: *Water table, *Groundwater storage, *Drawdown, Transmissivity, *Pumping tests, Aquifer testing, Artesian aquifers, Well hydrographs.

Long term storage in artesian and semiartesian aquifers was calculated from relatively short pumping tests (3-5 weeks) by studing the drawdown at the water table. Although the fluctuations are small under these conditions, results may be improved by performing the tests during dry periods such as summer or frost, choosing wells with small daily fluctuations, and observing the largest possible number of wells in the observation area. Pumping tests were used to study two aquifers, at the Torkildstrup-Lillebraende Waterworks and at the Karup Waterworks, Denmark. The first was a white chalk aquifer overlain by a clay aquitard, and the second, an anisotropic aquifer 50-60 meters thick. Reasonable estimates of transmissivity were obtained using mathematical models created for drawdown at the water table from pumping of deep groundwater. (Cassar-FRC)
W82-01890

MORPHOLOGY, HYDROLOGY AND HYDROCHEMISTRY OF KARST IN PERMAFROST TERRAIN NEAR GREAT BEAR LAKE, NORTHWEST TERRITORIES,
National Hydrology Research Inst., Calgary (Alberta).
R. O. van Everdingen.
National Hydrology Research Institute, Paper No 11, Inland Waters Directorate Scientific Series No 114, 1981. 53 p, 32 Fig, 8 Tab, 53 Ref.

Descriptors: *Karst hydrology, Hydrologic measurements, *Precipitation, Rainfall, Geochemistry, *Snowmelt, Subsurface runoff, Bedrock stratigraphy, Permafrost, Sinkholes, Soluble rocks, Contaminants, Morphology, Stratigraphy, Great Bear Lake, *Northwest Territories, Canada.

Collapse karst is widespread in the Franklin Mountains, Colville Hills and Great Bear Plain between Great Bear River and 67 N. Collapse features in the area are interpreted as being the result of subsurface solution of evaporites from the Upper Cambrian Saline River Formation and the Lower Devonian Bear Rock Formation; they appear to be concentrated on and around a number of small 'domes' on the Keele Arch. Integrated surface drainage is limited or lacking over portions of the karst area. Hydrologic measurements (rates of inflow into sinkholes; water levels in seasonally flooded depressions; discharge from springs) indicate that subsurface runoff may be as high as 40 mm per year or about 15% of the annual precipitation and that rainfall rates as low as 6 mm per day can initiate recharge to the karst-water system. Results of deuterium and oxygen-18 analyses show that snowmelt provides a major portion of the recharge; tritium levels in discharge from springs indicate that residence times in the karst-water system are relatively short. Seasonal flooding of karst depressions may cause problems for future engineering developments in the region; the tendency of the karst to collapse presents a special geotechnical hazard in addition to the problems related to the widespread occurrence of ice-rich permafrost. The karst-water system is extremely vulnerable to contamination from the surface because of the close spacing of high-rate recharge points and the unfiltered nature of the recharge. Once a contaminant has entered the karst-water system, rapid subsurface transport will make containment, recovery and cleanup after an accidental spill difficult or impossible. (WATDOC)
W82-01904

MATHEMATICAL MODEL FOR REGIONAL LAND SUBSIDENCE DUE TO PUMPING 1. INTEGRATED AQUIFER SUBSIDENCE EQUATIONS BASED ON VERTICAL DISPLACEMENT ONLY,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. Bear, and M. Y. Corapcioglu.
Water Resources Research, Vol 17, No 4, p 937-946, August, 1981. 2 Fig, 2 Tab, 23 Ref.

Descriptors: *Subsidence, *Aquifers, *Compressibility, *Model studies, Mathematical models, Com-

paction, Groundwater mining, Piezometric head, Confined aquifers, Terzaghi equation.

A regional land subsidence model is developed using Terzaghi's concept of effective stress, essentially horizontal flow in the aquifer, and only vertical soil compressibility. First, the three-dimensional equation of (saturated) water mass conservation is obtained for the compressible fluid and solid matrix. This is then integrated over the aquifer's thickness, considering conditions on the top and bottom surfaces bounding the aquifer. The result is a flow equation in terms of averaged piezometric head. By relating changes in head to land subsidence, an equation for land subsidence as a single dependent variable results. Examples are given for single- and multi-layered confined aquifers and a phreatic aquifer. The equation is applied to pumping from a hypothetical 6-layered confined aquifer. (Cassar-FRC)
W82-01926

MATHEMATICAL MODEL FOR REGIONAL LAND SUBSIDENCE DUE TO PUMPING 2 INTEGRATED AQUIFER SUBSIDENCE EQUATIONS FOR VERTICAL AND HORIZONTAL DISPLACEMENTS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
J. Bear, and M. Y. Corapcioglu.
Water Resources Research, Vol 17, No 4, p 947-958, August, 1981. 4 Fig, 12 Ref.

Descriptors: *Subsidence, *Aquifers, *Compressibility, Model studies, Mathematical models, Compaction, Groundwater mining, Piezometric head, Confined aquifers, Biot's equations.

A model for regional aquifer consolidation due to pumping considers both vertical land subsidence and horizontal displacement. It is based on Biot's work on coupled three-dimensional consolidation. These equations are averaged over the vertical thickness of an aquifer, assuming shear-free boundaries and plane stress. An analytical solution is given for the case of a single well pumping from an infinite homogeneous isotropic aquifer. Estimates of changes in averaged values of piezometric head, vertical subsidence, and horizontal displacement can be obtained. About half the volume strain is produced by vertical subsidence and half by horizontal displacement. The piezometric head obtained for the special case of radial flow is identical to that obtained by non-coupled models. However, for general cases, non-coupled models which neglect horizontal displacement give vertical subsidence values twice that of the values obtained in the model described here. (Cassar-FRC)
W82-01927

THE STATISTICAL MECHANICAL THEORY OF GROUNDWATER FLOW,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, and S. Y. Chu.
Water Resources Research, Vol 17, No 4, p 885-892, August, 1981. 1 Fig, 25 Ref.

Descriptors: *Aquifers, *Statistical mechanics, *Energy equation, Fluid mechanics, *Groundwater movement, Porous media, Theoretical analysis.

Macroscopic differential equations of transport in porous media are derived according to statistical mechanics. The general method is applied to derive the balance of mass and of linear momentum in the groundwater component of an aquifer that is not deformed by water flowing through it. Statistical mechanics is used to define the components of the internal energy and to derive a microscopic equation of total energy balance. The partial specific internal energy and the kinetic energy of groundwater in a pore is affected by a force such as gravity, but the total energy of groundwater is not. The standard groundwater flow equation is shown to be a special case of the macroscopic equation of internal energy balance. The derivation of this equation is not connected with mass balance, but instead is the equation of internal energy balance for isothermal groundwater movement in a homogeneous, isotropic aquifer whose solid phases are unaffected by changes in groundwater pressure. (Cassar-FRC)
W82-01982

STEADY PERIODIC FLOW THROUGH A RECTANGULAR DAM,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Mathematics and Statistics.
J. H. Knight.
Water Resources Research, Vol 17, No 4, p 1222-1224, August, 1981. 11 Ref.

Descriptors: *Dupuit-Forchheimer theory, *Groundwater level, *Groundwater movement, Tidal effects, Oscillatory waves, Water level, Sea level, Reservoirs, Aquifers, *Coastal aquifers.

The Dupuit-Forchheimer formula (D-F) for discharge through a homogeneous rectangular dam gives the average discharge when reservoir levels oscillate, if the mean squares of the levels are used. In the case of steady oscillation, the time average of the pressure integral can be found, which leads to a generalization of the D-P discharge formula. In the tidal oscillation case, groundwater in a coastal aquifer responds to the tides, so that the equilibrium water level far from the sea equals the root mean square of the sea level. For a deep aquifer the water level is near mean sea level, and for a shallow aquifer, about 23% higher than mean sea level. The integral properties predicted for the D-F theory via the Boussinesq equation are exact in spite of controversy on the validity of the D-F assumptions that the pressure distribution is almost hydrostatic. (Cassar-FRC)
W82-01983

AN INTEGRAL TRANSFORM METHOD FOR THE LINEARIZED BOUSSINESQ GROUNDWATER FLOW EQUATION,
Cold Regions Research and Engineering Lab., Hanover, NH.
C. J. Daly, and H. J. Morel-Seytoux.
Water Resources Research, Vol 17, No 4, p 875-884, August, 1981. 11 Fig, 2 Tab, 10 Ref.

Descriptors: *Aquifers, *Velocity, *Potentiometric head, *Groundwater movement, Porous media, Confined aquifers, Unconfined aquifers, Water table, Anisotropy, Darcys law, Mass transfer, Boussinesq Equation.

The potentiometric head in nonhomogeneous aquifers under both steady and unsteady flow conditions is determined by an analytical procedure based on the use of orthogonal functions. Selection of the appropriate sets of orthogonol functions permits the solution of problems over finite, semi-finite, and unbounded domains. Continuous and differentiable solutions, which are especially important in accurate determination of velocity field, are produced. The solution can be directly calculated at any point in the domain of the problem at any time; no grid or discretization is needed. Flow problems subject to nonhomogeneous boundary conditions and constant gradient boundary conditions may be solved by the integral transform approach. Point source problems are solved by use of a Dirac forcing term in the differential equation. The technique is applied to one- and two-dimensional flow problems where conditions are described by the linearized Boussinesq equation and results in the expression of potentiometric heads in analytic form. Limitations of this technique are: (1) flow domains are restricted to a rectangular geometry, and (2) rapidly varying potentiometric fields require solution of large numbers of equations. (Cassar-FRC)
W82-01984

SCALE-DEPENDENT DISPERSION IN A STRATIFIED GRANULAR AQUIFER,
National Hydrology Research Inst., Ottawa (Ontario).
J. F. Pickens, and G. E. Grisak.
Water Resources Research, Vol 17, No 4, p 1191-1211, August, 1981. 17 Fig, 10 Tab, 77 Ref.

Descriptors: *Solute transport, *Sampling, *Dispersivity, Porous media, Tracers, Aquifers, Sand aquifers, Chalk River Nuclear Plant, Scale effects, *Groundwater movement, Hydraulic conductivity, Wells.

A constant value for dispersivity of 0.7 cm was found to be representative and independent of travel distance at the scale of an individual level within a sand aquifer at the Chalk River Nuclear Laboratories. The laboratory-scale dispersivity for sand from the study site was 0.035 cm. Differences in scale between the laboratory and individual level dispersivities result from the greater inhomogeneity in the aquifer and from averaging caused by the groundwater sampling system. Full-aquifer dispersivities (single well tests using I131 as a tracer) were 3 and 9 cm. This indicates a scale effect with the value obtained dependent on the effect of transverse migration of tracer between the layers and the total injection volume. In 2-well tests (using Cr51-EDTA tracer) the full-aquifer dispersivity of 50 cm was scale-dependent, controlled by the distance between the injection and withdrawal wells and hydraulic conductivity distribution in the aquifer. Expressions for scale-dependent full-aquifer dispersivity (as a function of the mean travel distance) related distance to the statistical properties of a stratified geologic system where the hydraulic conductivity distribution is normal, log normal or arbitrary. These results show the importance of the groundwater sampling scale in interpreting values of dispersivity. (Cassar-FRC)
W82-01986

APPLICATIONS OF AERIAL PHOTOGRAPHY,
For primary bibliographic entry see Field 7B.
W82-01988

HYDRAULIC CONNECTION BETWEEN LAKE MICHIGAN AND A SHALLOW GROUNDWATER AQUIFER,
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
D. S. Cherkauer, and B. Zvibleman.
Ground Water, Vol 19, No 4, p 376-381, July/August, 1981. 7 Fig, 22 Ref.

Descriptors: *Hydraulic gradient, *Aquifers, *Lake beds, *Lake Michigan, Carbonate aquifers, Sediments, Lakes, Plumes, Recharge, Groundwater recharge, Hydraulic conductivity, Groundwater movement, Permeability, *Surface-groundwater relations.

Heavy pumping from a dolomite aquifer, source of water for the City of Mequon, Wisconsin, on the Lake Michigan shore, reversed the natural hydraulic gradient and allowed lake water to flow into the aquifer. In July 1978, high quality lake water (total dissolved solids, 200 ppm) was identified as a plume extending about 2 km into the aquifer (600-800 ppm total dissolved solids). The hydraulic connections between lake and aquifer are located in the lake bed, where areas of thin sand and gravel sediment contact permeable bedrock ridges. Flow seems to follow the ridges toward the center of the cone of depression formed in the aquifer by heavy pumping. In the spring of 1979 recharge and reduced pumping produced changes in configuration and reduction in size of the plume. (Cassar-FRC)
W82-02010

EXTENSION OF THE INTEGRODIFFERENTIAL APPROACH TO INHOMOGENEOUS MULTIAQUIFER SYSTEMS,
Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Investigaciones en Matematicas Applicadas y en Sistemas.
J. P. Hennart, R. Yates, and I. Herrera.
Water Resources Research, Vol 17, No 4, p 1044-1050, August, 1981. 2 Fig, 11 Ref.

Descriptors: *Leaky aquifers, *Heterogeneity, Aquitards, Groundwater movement, Aquifers, Model studies, Mathematical models, *Aquifer systems.

The integrodifferential model for multiaquifer systems, which assumes homogeneity in the vertical direction, has been extended to general heterogeneous multiaquifer systems. This paper develops an approach for a heterogeneous leaky aquifer system in which properties of the system are arbitrary functions of position in both horizontal and vertical directions. Aquitards are eliminated, leading to a system of integrodifferential equations. Details of numerical implementation of the system are given with particular emphasis on efficient approximation of the horizontal heterogeneity in the aquifers and on the use of a class of finite element in time integration schemes, including most well-known time integration schemes and leading to consistent updating formulas for the memory and influence terms. (Cassar-FRC)
W82-02017

GROUNDWATER CHEMISTRY OF SOME SELECTED AREAS IN SOUTHEASTER NORWAY,
Norges Landbrukshoegskole, Vollebekk.
For primary bibliographic entry see Field 2K.
W82-02020

TERRAIN, GROUNDWATER AND SECONDARY SALINITY IN VICTORIA, AUSTRALIA,
Soil Conservation Authority of Victoria, Kew (Australia).
J. J. Jenkins.
Agricultural Water Management, Vol 4, No 1/3, p 143-171, 1981. 11 Fig, 5 Tab, 24 Ref.

Descriptors: *Salinity, *Soil properties, *Groundwater pollution, Water pollution sources, Groundwater movement, Groundwater hydrology, Terrain analysis, Topography, Hydrology, *Victoria, Australia.

The problems of increasing secondary salinity in Victoria, Australia, are reviewed. Regional and local geological conditions including land form, the present and past climate and its ecological effects, and the specific forms of land use applied all affect the degree of salinization insofar as area and severity are concerned. Salinization occurs in all but the highest and wettest areas in Victoria. The dryland salinity phenomena can only be explained in terms of groundwater movement. Soil throughflow is clearly inadequate in all the Victorian physiographic situations in which persistent salting occurs. Reasons for this include an inadequate quantity of available soluble ions stored in the soil to maintain continuing salt seeps, the excessively low horizontal hydraulic conductivities of the soil compared with their substrates, and the presence of saline groundwater either unconfined or under pressure, or frequently both. The major controlling factor in salinization is the water recharge-discharge system. Any solution must therefore involve the control of water both at and below the surface. The additional recharge which follows clearing must be prevented, and the pressures which have built up in confined aquifers and water tables which have risen must be reduced. In order to control the problem, a detailed knowledge of the conditions prevailing in each area in relation to the causative factors involved must exist. The corollary of a permanent reduction in soil salting therefore is a corresponding improvement in water supply quality. (Baker-FRC)
W82-02046

EXCESS AIR IN GROUNDWATER,
Council for Scientific and Industrial Research, Pretoria (South Africa). Natural Isotopes Div.
T. H. E. Heaton, and J. C. Vogel.
Journal of Hydrology, Vol 50, No 1-3, p 201-216, March, 1981. 4 Fig, 3 Tab, 24 Ref.

Descriptors: *Recharge, *Soil gases, *Air entrainment, *Nitrogen, *Argon, Groundwater, Infiltration, Excess air, South Africa.

Examination of dissolved nitrogen and argon in 81 groundwater samples from 6 areas in South Africa showed that many samples contained air in excess (up to 10 ml per kg water) of the amount expected for equilibrium in the atmosphere. The excess gas is ascribed to the solution of air bubbles trapped by infiltrating water in the unsaturated zone during recharge. Data show that N and A concentrations have not been significantly modified by chemical reactions, such as nitrification, or radioactive decay within the aquifer. Factors that favor air entrapment are fine soil with its small pores and narrow capillary channels and intermittent recharge caused by heavy rainfall interspersed with long dry periods. (Cassar-FRC)
W82-02099

2G. Water In Soils

SIMULATION OF THE TOPOGRAPHIC INFLUENCE ON SLAR DATA FOR SOIL MOISTURE DETECTION IN A HILLY AREA,
Eidgenoessische Technische Hochschule, Zurich (Switzerland). Versuchsanstalt fuer Wasserbau, Hydrologie und Glaziologie.
R. Meier.
Remote Sensing of Environment, Vol 11, No 2, p 245-251, July, 1981. 6 Fig, 5 Ref.

Descriptors: *Soil water, *Remote sensing, *Model studies, Topography, Terrain analysis, *Radar, Moisture profiles, Simulation analysis, Mathematical studies, Catchment areas.

Although side-looking airborne radar (SLAR) has great potential for remote sensing of soil moisture conditions, the variability of the recorded signal in a hilly area can affect all of the other parameters which influence the signal. The effects of a hilly terrain may be minimized by estimating the influence of the topography on the microwave backscatter. A SLAR image may be simulated by a digital terrain illumination model. Grid elements of 50 m of a 3.2 sq km catchment were modeled and correlated to the corresponding model, with favorable results. Remaining variations were explained, to a great extent, by changes in soil moisture in the catchment area. The sensitivity of microwave backscatter to decreasing incidence angle was demonstrated when two extremely different moisture conditions were compared. The spatial distribution of soil moisture was unavailable due to inadequate spatial resolution of the heterogeneous catchment. (Geiger-FRC)
W82-01605

SOIL MOISTURE UPDATING AND MICROWAVE REMOTE SENSING FOR HYDROLOGICAL SIMULATION,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
T. J. Jackson, T. J. Schmugge, A. D. Nicks, G. A. Coleman, and E. T. Engman.
Hydrological Sciences Bulletin, Vol 26, No 3, p 305-319, September, 1981. 5 Fig, 7 Tab, 19 Ref.

Descriptors: *Model studies, *Soil moisture, Remote sensing, Microwaves, Radiation, Soil water.

The possibility of measuring soil moisture in the upper soil layer using microwave remote sensing was investigated. Four different simulations were performed on each of the four basins studied. The first two simulations compared the effects of using daily total and breakpoint precipitation input data. The second two simulations resembled the first two, except that in addition soil moisture updating was performed. This was accomplished by modifying the model to read in all of the observed soil moisture values and store them. When the simulation reached a day on which soil moisture was measured, the measurements were substituted for the current simulation values of both soil layers. The findings indicate that both soil moisture simulation and input rainfall were affecting the model stimulations. Using updates or breakpoint precipitation values individually did not improve the simulation, whereas using both did. It was concluded that soil moisture observations for updating are valuable when the model exhibits a bias in simulating soil moisture. A second problem relates to the particular model structure used. A third problem was the lack of sensitivity to soil moisture updates, which could be related to the spatial scale of the basins used in the studies. Finally, annual runoff was the only criterion used to judge the model's performance. Additional tests are needed. (Baker-FRC)
W82-01611

SIMPLE IN SITU DETERMINATION OF HYDRAULIC CONDUCTIVITY BY POWER FUNCTION DESCRIPTIONS OF DRAINAGE,
Hawaii Univ., at Manoa, Honolulu. Water Resources Research Center.
S. K. Chong, R. E. Green, and L. R. Ahuja.
Water Resources Research, Vol 17, No 4, p 1109-1114, August, 1981. 7 Fig, 1 Tab, 16 Ref. OWRT-B-054-HI(5).

Descriptors: *Hydraulic conductivity, *Drainage, *Hydraulic gradient, *Soil water, Infiltration, Pressure head, Darcys law.

A method of calculating soil hydraulic conductivity from field measurements of soil water content and soil water pressure head during infiltration and redistribution was developed. This method is applicable to a wider range of soil water contents than the Nielsen et al. (1973) method for estimating hydraulic conductivity. A unit hydraulic gradient was assumed, and a power function described the changes in water content and pressure head with time during the redistribution period. The method was used at 7 experimental sites (tilled sugar cane fields on oxisols) at Oahu, Hawaii, where the total hydraulic head gradient varied from 0.3 during early stages of drainage to 2.0 after several days. Unit hydraulic gradient was usually approached during the intermediate stages of drainage (1,000-10,000 min), and this is the point where hydraulic conductivity values would be most reliable. Comparisons with the more complicated Darcy method showed that the simplified method was reliable for field use in well-drained soils. (Cassar-FRC)
W82-01666

SIMULATION OF WATER AND NITROGEN MOVEMENT AND NITROGEN TRANSFORMATIONS IN FOREST SOILS,
Washington State Univ., Pullman. Dept. of Agronomy and Soils.
S. J. Riha.
PhD Dissertation, 1980. 174 p, 33 Fig, 25 Tab, 65 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No. GAX80-25956.

Descriptors: *Soil moisture, *Nitrogen cycle, *Model studies, Forest soils, Soil water, Soil water movement, Water transport.

A model was developed to simulate rates of nitrogen transport and transformation in forest soils under Douglas-fir. Simulations were run for soils which were undisturbed, fertilized with urea-N or in which no root uptake of nitrogen was occurring. The model required inputs of basic soil, microbe, and plant characteristics. Environmental inputs were daily precipitation and maximum and minimum air temperature. The model predicts the rates of mass flow and diffusion of nitrogen to roots, immobilization of NH4+ by soil heterotrophs, mineralization of organic nitrogen by heterotrophs, nitrification of NH4+ by autotrophs and leaching of nitrogen below the root zone. The model was tested against water and nitrogen data collected in the field. Soil water flow was modeled using a one-dimensional finite element numerical solution of the Richards equation. Solutes were assumed to be transported by convection with the water. Rates of nitrogen transformation and active root uptake were described by Michaelis-Menten equations. It was assumed that tree roots, heterotrophs, and autotrophs compete simultaneously for soil NH4+. The flux of NH4+ to these three groups was assumed to be limited by the diffusion of NH4+ within the soil which has made a function of the water content of the soil. The model predicted fairly constant levels of NH4+ throughout the year and in general a return to these levels after a forest soil is perturbed. In an undisturbed soil, it was estimated that approximately 10% of the total nitrogen mineralized is immobilized, 45% diffuses to roots, and 45% is nitrified. (Sinha-OEIS)
W82-01668

EFFECT OF PERIODS OF MOISTURE AVAILABILITY ON GROUNDNUT CROP IN THE SAURASHTRA REGION OF GUJARAT,
Bansilal Amritlal Coll. of Agriculture, Anand (India).
K. R. Patel, and P. D. Mistry.
Indian Journal of Agricultural Sciences, Vol 51, No 4, p 266-270, April, 1981. 5 Tab, 11 Ref.

Descriptors: *Soil moisture, *Crop yield, Groundnut, Rainfall, Moisture availability, Soil water, Available water, Moisture content, *Soil-water-plant relationships, *India.

The probable period(s) of availability of soil moisture were estimated by the water budget technique in groundnut, which is rainfed in the Saurashtra region of Gujarat, India. Daily temperature data for the 1960-1974 period were collected, along with information on field capacity, bulk density and permanent wilting point as well as root depth at different stages of plant growth. The rainfall was taken as the income and evapotranspiration as the loss of water. Potential evapotranspiration was computed according to Thornthwaite's formula and was adjusted by multiplying with the day-length factor for different months during the growing season. The analysis indicated that the yield of groundnut was linearly related to the percentage of moisture available days on fitting a linear equation. On the average, a 60% reduction in yield was noted as due to lack of adequate soil moisture. The crop suffered for want of soil moisture in a majority of the years. The short duration bunch variety was found to be more suitable than the spreading type. The stations studied were ranked in suitability for groundnut production. (Baker-FRC)
W82-01708

LEACHING OF FERTILIZER IONS IN A ULTISOL FROM THE HIGH RAINFALL TROPICS: LEACHING THROUGH UNDISTURBED SOIL COLUMNS,
International Inst. of Tropical Agriculture, Ibadan (Nigeria).
J. L. Pleysier, and A. S. R. Juo.
Soil Science Society of America Journal, Vol 45, No 4, p 754-760, July/August, 1981. 7 Fig, 5 Tab, 24 Ref.

Descriptors: *Nitrate, *Leaching, *Soil columns, Fertilizers, Ion transport, Infiltration, Aluminum, Calcium, Potassium, Magnesium, Tropical regions, Excess rainfall.

The leaching and downward movement of Ca(+2), K(+1), Mg(+2), and NO3(-1) applied to the barge surface of undisturbed soil columns of a Ultisol (Typic Paleudult) from the high rainfall region of southeastern Nigeria were studied. The soil columns were leached with 2420 mm of water, the average annual rainfall at the sampling site. Nitrate added in the form of Ca, Mg, or K salts leached readily through the profile. The leachability of cations was K less than Al which was about the same as Ca and Mg but less than Na. Nitrate was accompanied mainly by Al(+3) ions. When the profile contains a high degree of exchangeable Al saturation, the downward movement of Ca may be predicted by Walter's formulation of ion exchange chromatography. Because nitrate leached along with Al(+3) ions in the strongly acid Ultisols, it is questionable whether common crop and fallow plant species would be capable of utilizing the subsoil nitrate in this environment. (Small-FRC)
W82-01721

SIMULATION OF SOIL WATER WITHIN THE ROOT ZONE OF A CORN CROP,
Kentucky Univ., Lexington. Dept. of Agronomy.
D. Radcliffe, T. Hayden, K. Watson, P. Crowley, and R. E. Phillips.
Agronomy Journal, Vol 72, p 19-24, January/February, 1980.

Descriptors: *Soil-water-plant relationships, *Corn, *Root zone, Model studies, Agriculture, Soil water, Infiltration, Evaporation, Transpiration, Drainage, Leaf area index.

A model was developed to calculate the infiltration, evaporation, transpiration and deep drainage of soil water in the root zone of corn (Zea mays L.) throughout a growing season. Inputs are data such as solar radiation, maximum and minimum temperature, leaf area index, and rainfall. Components of the model are potential evaporation, leaf area index, infiltration and distribution of surface water, and uptake of water. This model incorporates the effect on the distribution of rainwater due to channelizing in the cracks and non-capillary pores of a highly structured soil. The model was tested on two soils using soil moisture records from 4 years in one case and 1 year in the other. Agreement of simulated and actual soil water contents in silt loams in Kentucky was good. Two methods of modeling plant uptake of soil water, mechanistic and empirical, were very similar in accuracy. (Cassar-FRC)
W82-01834

EFFECT OF BULK DENSITY ON CALIBRATION OF NEUTRON MOISTURE PROBE FOR ORGANIC SOILS,
Florida Univ., Belle Glade. Dept. of Agricultural Engineering.
G. S. Rahi, and S. F. Shih.
Transactions of the ASAE, Vol 24, No 5, p 1230-1233, 1240, September-October, 1981. 4 Fig, 2 Tab, 19 Ref.

Descriptors: *Soil water, *Density, Measuring instruments, *Organic soils, Soil types, Peat soils, Soil organic matter.

The effect of bulk density on water content estimation by the neutron probe was evaluated, a technique to improve the water content estimation was developed, and the performance of the technique was compared in relation to the original calibration curve. The bulk density significantly affected the water content measurements in organic soils if the neutron thermalization technique was used to monitor the water content. The original calibration curve in the laboratory studies indicated a difference of up to 0.10 cubic centimeter/cubic centimeter in volumetric water content for a bulk density difference of only 0.04 g/cubic centimeter in soil wetted to identical water contents. Volumetric water content over a depth of 75 cm in lysimeters varied between 0.006 to 0.167 cubic centimeters/cubic centimeter when gravimetric determination was compared with the calibration curve estimation. Bulk density of organic soil at different depths in lysimeters ranged from 0.26 to 0.37 g/cubic centimeter. A modified technique was tested to adjust neutron count ratio to account for differences in bulk density. The technique was based on the relation between count ratio and macroscopic neutron cross section of components of soil, including water. The water content estimated by the modified method was more precise than that determined by the original method. The measured water content differences between the gravimetric method and the original method decreased by 50 to 90% with the modified method. (Baker-FRC)
W82-01861

TRANSPORT OF SALTS IN CATCHMENTS AND SOILS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
T. Talsma.
Agricultural Water Management, Vol 4, No 1/3, p 103-113, 1981. 4 Fig, 2 Tab, 25 Ref.

Descriptors: *Salts, *Soil properties, Catchment areas, Rainfall-runoff relationships, Catchment basins, Water pollution sources, *Watersheds, Convection, Diffusion coefficient, *Saline soils, Runoff, Stream discharge, *Australia.

A rapid assessment technique was used to measure and evaluate catchment hydraulic conductivity at various soil depth intervals. The mean hydraulic conductivities were shown to provide a satisfactory basis for explaining the contrasting runoff hydrographs. Changes in the quality of streamwater in relation to runoff were considered for the Picadilly catchment with deep and permeable soils, and for the Greens catchment with shallow and slowly permeable soils. Total salinity, as well as potassium concentration, varies very little with increasing discharge at Picadilly. Different relationships were apparent for the Greens catchment, where the dilution of salt concentrations in groundwater with substantial quick return and overland flow at high discharge rates yielded a decreasing relationship between electrical conductivity and discharge rate, with low overall electrolyte concentration at high discharge. The transport of salt through leaching occurs via water which does not join the stream as surface runoff, but instead enters the soil profile. In studies on the Picadilly catchment, a 90 kg/ha surface applied potassium chloride solution was leached through the soil. Soluble chloride did not move beyond 1.2 meters soil depth, and became increasingly adsorbed in the deeper part of the soil profile. It was concluded that solute concentrations reaching stream water in catchments, with soils of similar chemical properties as at Picadilly, would be very much retarded and strongly attenuated. Measured soil properties were also used to examine the critical water table depths for surface soil salinization under irrigated and dryland conditions. (Baker-FRC)
W82-01880

PENETRATION AND DISTRIBUTION OF TRITIATED WATER IN SOILS OF A LYSIMETER,
Eotovs Lorand Univ., Budapest (Hungary). Dept. of Physical Chemistry and Radiology.
P. Fodor-Csanyi, S. Takala, L. Alhonen-Hongisto, J. K. Miettinen, and G. L. Horvath.
Nordic Hydrology, Vol 11, No 3/4, p 169-186, 1980. 11 Fig, 5 Tab, 9 Ref.

Descriptors: *Tritium, *Soil water, *Infiltration rate, Radioactive tracers, Tracers, Lysimeters, Gravel, Sand, Soil types.

The movement of tritiated water was much faster through gravel than through fine sand in lysimeter experiments, started June 21, 1977, in Finland. Simulated precipitation (30-60 mm) was applied to three plots of soil, 10 sq meters and 1.5 meters deep, one containing gravel and two containing fine sand, all without plants. Under the same amount of rain and irrigated water, the total tritium activity (or tritium pulse) in gravel was between 30-45 cm the second day and between 45-60 cm the eighth day. There was nearly zero activity between 0 and 135 cm at 150 days. In the fine sand plots, the maximum tritium activity was located at 15-30 cm after 34 days, and at 60-135 cm after 1 year. Velocity of infiltration in gravel was 16 cm per day at the beginning of the experiment and 6 cm per day at the end; in sand, 0.5 cm per day. The tritium activity reached the lysimeter bottom considerably later than predicted by a mathematical equation. (Cassar-FRC)
W82-01886

PROPERTIES OF THE SORPTIVITY FOR EXPONENTIAL DIFFUSIVITY AND APPLICATION TO THE MEASUREMENT OF THE SOIL WATER DIFFUSIVITY,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
R. D. Braddock, J. Y. Parlange, and I. G. Lisle.
Soil Science Society of America Journal, Vol 45, No 7, p 705-709, July/August, 1981. 3 Tab, 29 Ref.

Descriptors: *Soil water, *Sorption, *Diffusion coefficient, Mathematical studies, Soil properties.

The integral relation used to calculate diffusivity developed by Parlange et al. (1980) is replaced by an expression which is exact when the soil-water diffusivity obeys an exponential law. This new expression will be more appropriate for normal soils. The power law or exponential function can be used where the diffusivity depends on the water concentration. The exponential case is related to the power case, but there are some complications. Some of the properties of the solutions are generated. Sorptivity can be represented by a simple relation to a universal function of the water content. Optimization method results are compared with results obtained here, and both are applied to the

measurement of soil-water diffusivity. Also, the method can be used to determine soil-water diffusivity when sorptivity is measured for variable water content at the surface. (Small-FRC)
W82-01897

EFFECT OF FIELD VARIABILITY IN SOIL HYDRAULIC PROPERTIES ON SOLUTIONS OF UNSATURATED WATER AND SALT FLOWS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Dept. of Soil Physics.
D. Russo, and E. Bresler.
Soil Science Society of America Journal, Vol 45, No 4, p 675-681, July/August, 1981. 6 Fig, 1 Tab, 17 Ref.

Descriptors: *Soil properties, *Permeability coefficient, *Flow, Salt, Spatial distribution, Soil properties, *Unsaturated flow, Mathematical studies, *Soil water, Hydraulic conductivity.

The extent to which the inherent spatial variability of soil hydraulic properties influences water and salt flow distributions was investigated. Also, predicted salt and water flows are examined in terms of their structures and their effects on the utilization of field-measured soil data. The governing water and salt flow equations are solved numerically using actual field data of soil hydraulic conductivity and differential water capacity. The data were from measurements made in 30 different field locations and matched data obtained from a Monte-Carlo simulation that considered the correlations between the parameters of the hydraulic functions. Simulated values of variables were used to estimate distribution types and its moments for pressure head, water fluxes, wetting front position, and solute concentration. Distances in the field where the horizontal flow components were negligibly small compared to vertical flow components were about 10 cm. Values of field scale dispersivity were larger than pore scale dispersivity and increased with soil depth. (Small-FRC)
W82-01898

THE INFLUENCE OF TILLAGE ON SOIL WATER BEHAVIOR,
Western Australia Univ., Nedlands. Dept. of Soil Science and Plant Nutrition.
A. P. Hamblin, and D. Tennant.
Soil Science, Vol 132, No 3, p 233-239, September, 1981. 5 Fig, 2 Tab, 12 Ref.

Descriptors: *Soil water, *Available water, *Agricultural engineering, *Wheat, Farming, Sand, *Australia, Soil types, Water conservation, Soil-water-plant relationships, Climates.

A soil water study was performed at a site located in the West Australian wheat belt which has a Mediterranean climate. Of the annual average rainfall of 348 mm, 83% falls between May and October. The soil is a deep yellow sandy loam of weak, incohesive structure, overlying sandy lateritic gravel occurring at 1.5 to 2 meters, containing 10% clay and having 1.2% organic matter in the top 10 cm. The site was cropped to lupins in the year before the study and then cropped to wheat for three consecutive years. Undisturbed 5.5 and 7.0 cm diameter cores were taken from the surface 10 cm for measuring soil physical parameters. Three intensities of tillage disturbance were then imposed for the three successive years. One intensity was a conventional district practice (CON) of one disk ploughing, one pass with a scarifier, and seeding with a tyne-drill (combine). The second method involved a minimum tillage treatment (MIN) consisting of one application of paraquat-diquat at 2 liters per ha, followed by tyne-drill seeding. The third technique involved a zero tillage treatment (ZERO) using the same herbicide, but followed by seeding with a triple-disk seeder. The CON treatment disturbed the soil to about 10 cm, the MIN to about 4 cm, and the ZERO cut only shallow slots, between which the soil was not disturbed. The findings of the study infer that, whereas most soil water could be lost through drainage from the ploughed treatment in a wet year, most soil evaporation will take place from the direct drilled soil (especially zero tillage), and during the average growing season, water will move more rapidly within the ploughed profile than in the other two treatments. Where direct drilling is adopted on sandy soils, minimum rather than zero tillage should be the aim. (Baker-FRC)
W82-02022

DIRECT EVIDENCE OF WATER-SOLUBLE ORGANIC MATTER LEACHING IN BROWN EARTHS AND SLIGHTLY PODZOLIZED SOILS,
Luxembourg Foundation Univ., Arlon.
J. Herbauts.
Plant and Soil, Vol 54, No 2, p 317-321, 1980. 2 Tab, 14 Ref.

Descriptors: *Organic matter, *Leaching, Soil porosity, Carbon, Lysimeters, Moisture meters, Soil moisture, Podzols, Soil types, Nitrogen, *Brown soils.

The leaching of organic carbon, organic nitrogen and mineral nitrogen was measured at different depths in four different forest soils using semi-active tension lysimeters. Drainwaters were collected in the soil under surface holorganic layers and under the humic layer. Precipitation beneath forest canopy was simultaneously collected with pluviometers at each lysimeter site. Determination of organic carbon was made using a Dohrmann DC-50 Total Organic Carbon Analyzer. Inorganic nitrogen was determined colorimetrically and total nitrogen measured after a sulfo-perchloric pretreatment. Organic carbon contents in waters collected beneath forest canopy were similar at the two study sites, with a seasonal fluctuation apparently related to the amount of rainfall. Under leaf litter layers, leachates were enriched in water-soluble carbon, and this enrichment was stronger under holorganic layers of the brown podzolic soil. Under humic layers the organic carbon concentrations of leachates were appreciably lower than under holorganic layers, but the decrease is less pronounced beneath the moder than beneath the mull. Mobilization of organic carbon beneath the horizons is always higher in weakly podzolized soils than in non-podzolized acid brown earth. The contents of mineral nitrogen are usually higher in the brown soil, probably as a consequence of contrasting nitrogen mineralization rates in the humic layers of these soils. (Baker-FRC)
W82-02034

WAYS OF SUCCESSIVE REFINEMENT OF METHODS OF CALCULATING THE DUTY OF WATER,
Akademiya Nauk SSSR, Moscow. Inst. Vodnykh Problem.
For primary bibliographic entry see Field 2D.
W82-02094

2H. Lakes

A METHOD OF OBJECTIVE ANALYSIS FOR CURRENTS IN A LAKE WITH APPLICATION TO LAKE ONTARIO,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. B. Rao, and D. J. Schwab.
Journal of Physical Oceanography, Vol 11, No 5, p 739-750, May, 1981. 8 Fig, 4 Tab, 14 Ref.

Descriptors: *Lakes, *Mathematical studies, *Wind-driven currents, *Water circulation, Great Lakes, *Lake Ontario, Vortices, Mathematical equations, Water currents, Lake basins, Flow pattern, Air circulation.

The flow field of large lakes was represented in terms of transport stream function based on the observation that the mean circulation in large lakes is almost non-divergent in character. An equation was formulated in which the transport stream function may be calculated when the vorticity field is known. Another equation is provided for the determination of the current vector. However, since currents are measured and not vorticity, the proposed objective analysis method expands the transport streamfunction in terms of the eigenvectors of a third equation. A Lanczos procedure is used to calculate the eigenvalues and eigenvectors which are characteristic of a particular lake. The expansion coefficients are determined by minimizing the squared error between the calculated horizontal velocity vector field and available current meter data. Currents may be reconstructed at any point, since the eigenvector functions are known for the entire domain of the basin. The present procedure has been used in gathering winter data from Lake Ontario in connection with the International Field Year for the Great Lakes. (Geiger-FRC)
W82-01616

ABUNDANCE, LIFE HISTORY, AND GROWTH OF INTRODUCED POPULATIONS OF THE OPOSSUM SHRIMP (MYSIS RELICTA) IN SUBALPINE CALIFORNIA LAKES,
California Univ., Davis. Div. of Environmental Studies.
M. D. Morgan.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 989-993, August, 1981. 4 Fig, 2 Tab, 12 Ref.

Descriptors: *Opossum shrimp, *Productivity, *Growth, *Lakes, Donner Lake, Fallen Leaf Lake, Lake Tahoe, *California, Invertebrates, *Fish food, Population growth, Ecosystems, Fish populations.

Lake productivity was an important factor in the growth of opossum shrimp (Mysis relicta), introduced into Donner Lake and Fallen Leaf Lake, California, in 1965. This species is important in the food dynamics of fish populations. The overall densities of populations in Donner Lake were 238 per sq meter in August 1978, 123 per sq meter in June 1979, and 108 per sq meter in November 1980. In Fallen Leaf Lake, the densities were 114 per sq meter in August 1978 and 103 per sq meter in June 1979. These figures indicate that the mysids are well-established throughout both lakes. Mysids reproduced in the spring at ages 1 and 2 years, living for 2 years. In nearby Lake Tahoe, a much less productive lake, the growth rate of mysids was much slower, taking twice as long to reach similar population densities. The Lake Tahoe population was not reproductive during its first 2 years. (Cassar-FRC)
W82-01638

RELATIONSHIPS BETWEEN NANNOPLANKTON AND LAKE TROPHIC STATUS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-01640

DESTRATIFICATION AND REAERATION AS TOOLS FOR IN-LAKE MANAGEMENT,
Salford Univ. (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W82-01648

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS, 1968-73. I. THE EFFECTS OF EUTROPHICATION ON STANDING CROP AND COMPOSITION OF PHYTOPLANKTON,
Nebraska Univ., Lincoln. School of Life Sciences.
For primary bibliographic entry see Field 5C.
W82-01653

PHYTOPLANKTON PHOTOSYNTHESIS AND ITS RELATION TO STANDING CROP AND NUTRIENTS IN TWO WARM-MONOMICTIC SOUTH ISLAND LAKES,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
S. F. Mitchell, and C. W. Burns.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 51-67, 1981. 8 Fig, 6 Tab, 58 Ref.

Descriptors: *Seasonal variation, *Phytoplankton, *Photosynthesis, Nutrients, Standing crops, Phos-

phate, Nitrates, Algal blooms, Stagnant water, Lakes, *New Zealand, Eutrophication, Lake Hayes, Lake Johnson.

Lake Hayes and Lake Johnson, New Zealand, were assessed for seasonal and vertical changes in phytoplankton, photosynthesis, chlorophyll, nutrients, pH, and major ions over a two-year period. These results were related to previously published results for phytoplankton species composition and standing crop, zooplankton, and oxygen for the same period. Accumulations of the nutrients PO4-P and NH4-N in the anoxic hypolimnia were important cyclic phenomena. In the autumn, surface concentrations of PO4-P reached 40-50 mg/cu m and NH4-N reached 150-400 mg/cu m, while the surface maxima of NO3-N were 26 mg/cu m in Lake Johnson and 60 mg/cu m in Lake Hayes. In 1970, Lake Johnson had a large accumulation of chlorophyll degradation products in the anoxic hypolimnion, and metalimnetic maxima were record occasionally. Stagnation was related to annual minima of photosynthesis and chlorophyll, with secondary minima occurring in winter. Autumn increases in photosynthesis and total chlorophyll content of the lakes were related to nutrient entrainment as the thermocline sank. In some summers, algal blooms were related to PO4-P concentrations. (Small-FRC)
W82-01700

BENTHIC MACROINVERTEBRATES OF LAKE TAUPO,
Department of Scientific and Industrial Research, Taupo (New Zealand). Ecology Div.
D. J. Forsyth, and I. D. McCallum.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 41-46, 1981. 3 Fig, 3 Tab, 13 Ref.

Descriptors: *Macroinvertebrates, *Seasonal variation, *Lakes, Lake sediments, Population density, Water depth, Oligochaetes, Snails, Midges, Lake Taupo, *New Zealand, Benthic fauna, Bays, Sediments, *Limnology.

The seasonal abundance of benthic macroinvertebrates was determined as part of a study of the limnology of Lake Taupo. Samples were collected from the profundal zone and from two transects from the littoral to the profundal zone of Lake Taupo from August 1974 to July 1975. Samples were also collected from Lake Taupo's six bays in the winter of 1975 and 1976. Chironomus zealandicus Hudson dominated chironomid populations at most sites, and Potamopyrgus antipodarum or oligochaete worms dominated the fauna at most sites. Seasonal changes in population densities were noticed. Oligochaetes dominated the fauna in four of the bays, and P. antipodarum was dominant in two bays. In the Lake Taupo area there were fewer than eight species of chironomid, four of gastropod mollusc, and two fo bivalve mollusc, along with the oligochaete worms. The annual mean standing crop of total microinvertebrates was 714 + or - 76 per sq m. Differences in species composition between the profundal zone and the transects were due to the depth preferences of different species. (Small-FRC)
W82-01702

LIMNOLOGY OF LAKE REREWHAKAAITU,
Waikato Univ., Hamilton (New Zealand). School of Science.
M. A. Chapman, V. H. Jolly, and E. A. Flint.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 2, p 207-224, 1981. 8 Fig, 4 Tab, 33 Ref.

Descriptors: *Limnology, *Lake morphometry, *Agricultural watersheds, Thermal stratification, Water depth, Lakes, Craters, Zooplankton, *Lake Rerewhakaaitu, *New Zealand.

The liminology of Lake Rerewhakaaitu was studied, and a comparison was made between the main lake and a connected, deeper crater lake. The lake has a catchment area of 4969 ha, of which 88% has been developed for agriculture, mostly dairy farming. Results emphasized the importance of morphometry. The main lake was usually homothermal, although temporary stratification occurred periodically and the oxygen content of the deeper water could be as low as 2 gm/cu m. The crater area had strong thermal and chemical stratification that persisted well into winter. Morphometry was related to the failure of the crater to become fully reoxygenated during its brief period of homothermy. Zooplankton populations of the two lakes also differed. In the main lake there were usually more bosmina but considerably fewer Ceriodaphnia and greater numbers of Piona. In the crater, adult Calamoecia were generally more abundant. (Small-FRC)
W82-01705

ON THE USE OF CAROTENOID STRATIGRAPHY IN LAKE SEDIMENTS FOR DETECTING PAST DEVELOPMENTS OF PHYTOPLANKTON,
H. Zullig.
Limnology and Oceanography, Vol 26, No 5, p 970-976, September, 1981. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Carotenoids, *Eutrophication, *Bottom sediments, *Lakes, Sedimentology, Lake sediments, Algal growth, Diatoms, Phytoplankton, Lake Zurich, *Switzerland.

The concentrations of certain carotenoids in cores of sediments were measured, and their accumulation rates over time were determined in an attempt to trace the development of the phytoplankton over the last 150-500 years in several eutrophic Swiss lakes. Ten lakes were investigated, and the results from Lake Zurich are presented and discussed. A method involving one-dimensional chromatography with four sequential development steps was used for the separation of plankton carotenoids and sediment carotenoids. Annual couplets of sediment are formed in the lake, consisting of black layers of iron sulfide formed from late summer until the beginning of winter and a light-colored layer of allochthonous clay deposited during spring and summer. The first sign of eutrophication occurred in 1896; sediments from this year contained the diatom Tabellaria fenestrata and the carotenoids fucoxanthin and diadinoxanthin. Later sediments indicated a wavelike development of the plankton, dominated by diatoms and 0. rubescens. Since 1970, oscillaxanthin has declined to the limit of detection, but other pigments are present. Algae are also still present, although there has been a decline. (Small-FRC)
W82-01706

RECENT CHANGES IN LEVEL OF LAKE VICTORIA,
Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga and Mobutu Sese Seko, Entebbe (Uganda).
For primary bibliographic entry see Field 4A.
W82-01711

ECOLOGICAL CHARACTERISTICS OF THE RHIZOSPHERE MICROFLORA OF MYRIOPHYLLUM HETEROPHYLLUM,
Massachusetts Univ., Waltham. Department of Environmental Science.
For primary bibliographic entry see Field 4A.
W82-01796

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS 1968-73. III. THE MACROINVERTEBRATE COMMUNITY: ITS DEVELOPMENT, COMPOSITION, AND CHANGE IN RESPONSE TO EUTROPHICATION,
Nebraska Univ., Lincoln. School of Life Sciences.
For primary bibliographic entry see Field 5C.
W82-01797

ABIOTIC VERSUS BIOTIC UPTAKE OF RADIOPHOSPHORUS IN LAKE WATER,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, D. R. Slavens, and L. M. Maloney.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 889-895, August, 1981. 4 Fig, 2 Tab, 26 Ref.

Descriptors: *Phosphorus removal, *Accumulation, *Algae, Lakes, Radioisotopes, Phosphorus radioisotopes, Selenastrum, Lake Michigan, Glutaraldehyde, Formaldehyde, Carbonylcyanide m-chlorophenylhydrazone, Inhibitors.

Carbonylcyanide m-chlorophenylhydrazone (CP), a phosphorylation inhibitor, was a more satisfactory agent for estimating abiotic uptake of radiophosphorus in lake water than the commonly-used glutaraldehyde or formalin. It effectively blocked biological P uptake and did not cause release of detectable amounts of inorganic P31 from algae into the water. Tests using Selenastrum capricornutum and Lake Michigan water showed that uptake of inorganic P33 in the presence of 0.001 mol per liter CP was less than or equal to 0.01% and that inorganic P31 release from microorganisms was nondetectable. When particulate matter recovered from heat- or glutaraldehyde- treated samples was resuspended in water, insignificant amounts of inorganic P33 were taken up, less than or equal to 2% of controls. Although P uptake in moderately buffered Lake Michigan water is almost exclusively biotic, waters with high concentrations of silt, clay, iron, calcium, or humic materials show considerable abiotic uptake. The CP method should produce the highest possible values for the abiotic mechanism in these waters. (Cassar-FRC)
W82-01824

METHANOGENESIS IN FRESHWATER SEDIMENTS: INHERENT VARIABILITY AND EFFECTS OF ENVIRONMENTAL CONTAMINANTS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W82-01825

THE ROLE OF PHOTOTROPHIC BACTERIA IN THE SULFUR CYCLE OF A MEROMICTIC LAKE,
Michigan State Univ., East Lansing. Dept. of Crop and Soil Sciences.
T. B. Parkin, and T. D. Brock.
Limnology and Oceanography, Vol 26, No 5, p 880-890, September, 1981. 7 Fig, 2 Tab, 29 Ref.

Descriptors: *Sulfur cycle, *Bacteria, *Meromictic lakes, Lakes, Sulfur, Photoropism, Agricultural watersheds, Hydrogen sulfide, Diurnal variation, *Lake Knaack, Wisconsin.

The sulfur cycle at the thermocline of meromictic Knaack Lake was investigated with emphasis on how the photosynthetic bacteria in the lake affect and are affected by these transformations. Sulfide in water samples was determined by the methylene blue method, which has a detection limit of 0.05 mg/liter. Oxygen, dissolved inorganic carbon, and bacteriochlorophyll were also determined. Knaack Lake has a surface area of 1.1 ha, a maximum depth of 22 m, and a mean depth of 7 m. It is located in central Wisconsin farmland. Sulfate concentrations were very low all year. In spring and summer, sulfate concentrations in the epilimnion ranged from 0.5 to 0.7 mg/liter and in the hypolimnion from 0.1 to 0.2 mg of SO4(-2) per liter. Elemental sulfur was found only during the partial mixing period in November, when 20-30 microgram S/liter was present throughout the water column. During the day, H2S was absent at the level of the green sulfur bacteria, but H2S built up at night. Carbon dioxide studies indicated that the green bacteria were photosynthetically active in the light and oxidized the H2S. (Small-FRC)
W82-01831

THE CONTRIBUTIONS OF TEMPERATURE AND THE INPUT OF ORGANIC MATTER IN CONTROLLING RATES OF SEDIMENT METHANOGENESIS,
Michigan Univ., Ann Arbor. Dept. of Environmental and Industrial Health.
C. A. Kelly, and D. P. Chynoweth.

Limnology and Oceanography, Vol 26, No 5, p 891-897, September, 1981. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Lake sediments, *Methane, *Temperature effects, Organic matter, Decomposing organic matter, Sediments, Lakes, Fluctuations.

The effects of temperature and of the supply of organic matter on rates of methanogenesis were studied in two freshwater lakes with different organic inputs and sediment temperatures. As was seen in earlier experiments, the natural cold-temperature methanolgenic rate in a particular sediment could be increased readily by increasing the temperature. When temperature was fairly constant for long periods such as during summer stratification, the rate of methane flux was directly proportional to and maximally adjusted to the rate of carbon input. Methane flux averaged 47% of organic input. Thus, when temperature changes rapidly, its effect will be predictably superimposed upon the effect of organic input. (Small-FRC)
W82-01832

RESONANT OSCILLATION IN DULUTH-SUPERIOR HARBOR,
Minnesota Univ., Duluth. Dept. of Physics.
T. F. Jordan, K. R. Stortz, and M. Sydor.
Limnology and Oceanography, Vol 26, No 1, p 186-190, January, 1981. 4 Fig, 3 Tab, 8 Ref.

Descriptors: *Resonance, *Harbors, *Oscillatory waves, Mathematical studies, Mathematical equations, *Lake Superior, Duluth, Minnesota, Water level fluctuations, Lakes, Flow characteristics.

The Duluth-Superior Harbor has two inlets to Lake Superior and a constriction separating the inner and the outer harbor. The masses of water moving in and out of the inlet channels can act as oscillators, coupled by the water level in the harbor and excited by oscillations of the lake level. Such oscillations at inlets to harbors, called Helmholtz resonances, can contribute significantly to mass movement and the flushing rate of a harbor. The dimensions of the Duluth-Superior Harbor and its inlets produce a Helmholtz resonance with a period comparable to the periods of free surface oscillations of Lake Superior, and the constriction may be considered as a possible third coupled oscillator. A Helmholtz resonance with a period of between 2.1 and 2.3 hours was calculated in the harbor. Some modes of oscillation of Lake Superior were found to have periods of about 2.0 and 2.3 hours. Spectral analysis of fluctuations of harbor water levels showed a mode of oscillation with a period of 2.1 hours. Analysis of water level oscillations in the harbor and currents in an inlet channel showed Helmholtz resonance periods of 2.1 hours, which seem to be excited by lake oscillations of nearly the same period. (Carroll-FRC)
W82-01837

FAYETTEVILLE, GREEN LAKE, NEW YORK: 3H-3HE WATER MASS AGES AND SECONDARY CHEMICAL STRUCTURE,
Australian National Univ., Canberra. Research School of Earth Sciences.
T. Torgersen, D. E. Hammond, W. B. Clarke, and T-H. Peng.
Limnology and Oceanography, Vol 26, No 1, p 110-122, January, 1981. 3 Fig, 8 Tab, 38 Ref.

Descriptors: *Meromictic lakes, *Chemocline, *Residence time, Chemical stratification, *Green Lake, *New York, Lakes, Isotope studies, Tritium, Helium, Limnology, Chemical analysis, Water analysis.

Green Lake, located near Fayetteville, New York is probably one of the most intensively studied meromictic lakes in the world. New chemical and isotopic measurements made in the lake in 1974 and 1975 are reported. The results of these measurements indicate the presence of an upper and a lower monimolimnion spearated by a secondary chemocline. The secondary chemocline, found at about 32.5 meters, is marked by distinct enrichments in S(2-), methane (CH4), total carbon dioxide N(+), and C1(-). Water mass ages were determined using tritium and tritiugenic helium. The upper monimolimion (16 to 32.5 meters) showed a mean annual age of 3.1 years, while the mean annual age of the lower monimolimnion was 5.8 years. The increased residence time of the S(2-) and CH4, which are produced in situ in the lower monimolimnion, causes enrichments of these substances at the secondary chemocline. A separate and probably diffuse groundwater input appears to be the most likely cause of Na(+), C1(-), He4, and sigma carbon dioxide enrichments and tritium depletions in the lower monimolimnion. The presence of a strong point source of groundwater to the upper monimolimnion at about 20 meters is suggested by the carbon 14, radon 222, and He3 profiles. New strontium 90 and cesium 137 measurements taken during this study are inconsistent with a previously published two-box model. (Carroll-FRC)
W82-01838

VOLTAMMETRIC STUDIES ON THE STABILITY OF THE ZN(II) CHELATES WITH NTA AND EDTA AND THE KINETICS OF THEIR FORMATION IN LAKE ONTARIO WATER,
Kernforschungsanlage Juelich, G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
B. Raspor, H. W. Nurnberg, P. Valenta, and M. Branica.
Limnology and Oceanography, Vol 26, No 1, p 54-66, January, 1981. 4 Fig, 6 Tab, 36 Ref.

Descriptors: *Zinc, *Chelating agents, *Organic matter, Lakes, Heavy metals, Chemical reactions, Kinetics, Voltammetry, Stability analysis, *Lake Ontario, Dissolved solids.

Voltammetric techniques were extended to the analysis of zinc NTA and zinc EDTA chelates in freshwater from Lake Ontario. Both of the ligands involved are more or less biologically nondegradable and reduce the toxicity of heavy trace metals by inhibiting their uptake by aquatic organisms through chelation. Differential pulse anodic stripping voltammetry was used to study the specific effects of ionic excess constituents, such as alkaline earth cations and chloride and hydroxide anions, on the stability and kinetics of formation of zinc (II) levels. Competition for the chelating ligands was found to have the most pronounced adverse specific effects on chelate stability. This was particularly true when the alkaline earth ions calcium (II) or magnesium (II) were present in substantial excess over the level of the heavy trace metals. While the results obtained in voltammetric studies of seawater are generally valid due to the rather constant macrocomponent composition and pH, inland waters have considerable diversity in composition, ionic strength, and pH. As a result, the concentrations of NTA and EDTA required to achieve a certain degree of chelation for a heavy trace metal in a certain type of water will give approximate information on the levels of the chelating components with chelator strength comparable to the dissolved organic matter required to attain a similar degree of chelation. It is also possible to develop estimates of the capacity of the dissolved organic matter for trace metal chelation and predictions of the significance of the particular kind of dissolved organic matter if the conditional stability constants of chelating components of the dissolved organic matter are known. (Carroll-FRC)
W82-01839

THE RELATIVE IMPORTANCE OF PROTOZOANS, ROTIFERS, AND CRUSTACEANS IN A FRESHWATER ZOOPLANKTON COMMUNITY,
Georgia Univ., Athens. Dept. of Zoology.
M. L. Pace, and J. D. Orcutt, Jr.
Limnology and Oceanography, Vol 26, No 5, p 822-830, September, 1981. 4 Fig, 2 Tab, 36 Ref.

Descriptors: *Zooplankton, *Protozoa, *Lakes, *Population density, Aquatic animals, Aquatic populations, Biological communities, Rotifiers, *Lake Oglethrope, Georgia.

The zooplankton community of Lake Oglethrope was sampled over a period of 13 months in this study of a macro- and microzooplankton association. Throughout the year, protozoans were numerically the most abundant organisms in the zooplankton, usually an order of magnitude greater than rotifers which were also abundant. Nauplii were abundant in winter. Macrozooplankton reached highest densities in May (Ceriodaphnia reticulata), October (Daphnia parvula and Diaptomus siciloides) and December (D. parvula and D. siciloides). Densities of protozoans were highest in the metalimnion, where scuticociliates bloomed in zones of intense bacterial activity. During these blooms, protozoa accounted for up to 62% of the zooplankton biomass. Protozoa are rarely included in studies of freshwater zooplankton communities, but since they make a significant contribution to rates of grazing, nutrient regeneration, and secondary productivity, they should not be ignored. (Small-FRC)
W82-01840

NITROUS OXIDE IN FRESHWATERS OF THE GREAT LAKES BASIN,
Cornell Univ., Ithaca, NY.
E. Lemon, and D. Lemon.
Limnology and Oceanography, Vol 26, No 5, p 867-879, September, 1981. 8 Fig, 4 Tab, 19 Ref.

Descriptors: *Nitrous oxide, *Great Lakes, *Seepage, Deep water, Surface effects, Diffusion models, Air-water interfaces.

The transport of nitrous oxide in the freshwaters of the Great Lakes Basin was investigated to determine the amount of seepage-water N20 from the land which enters streams, lakes, and the sea. Air and water samples were collected in the Great Lakes and Cayuga Lake. N20 was produced in a relatively 02-rich environment above the thermocline in deep water lakes and was reduced to N2 in the deeper, less oxic waters below the thermocline. Calcuation of N20 flux densities for the lakes indicated a wider range than has been reported for oceans. Two diffusion models were used to calculate exchange values of N20 between the atmosphere and the lakes. Groundwater under a large dairy farm was rich in N20, but once the N20 seeped into a headwaters tributary it was lost to the atmosphere. Generally, large amounts of N20 are dissolved in seepage or groundwater on the land, but once exposed to the open air, quickly disappeared into the atmosphere. (Small-FRC)
W82-01841

MORPHOLOGY, HYDROLOGY AND HYDROCHEMISTRY OF KARST IN PERMAFROST TERRAIN NEAR GREAT BEAR LAKE, NORTHWEST TERRITORIES,
National Hydrology Research Inst., Calgary (Alberta).
For primary bibliographic entry see Field 2F.
W82-01904

VARIANCE ESTIMATES FOR A DYNAMIC EUTROPHICATION MODEL OF SAGINAW BAY, LAKE HURON,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
D. Scavia, R. P. Canale, W. F. Powers, and J. L. Moody.
Water Resources Research, Vol 17, No 4, p 1115-1124, August, 1981. 2 Fig, 7 Tab, 56 Ref.

Descriptors: *Variation coefficients, *Error analysis, *Model studies, Mathematical models, Lakes, *Eutrophication, *Saginaw Bay, *Lake Huron, Algae, Nutrients, Phosphorus, Nitrogen, Zooplankton, Phytoplankton, Correlation coefficient.

First-order variance propagation was used to estimate variance in a eutrophication model output based on variable initial conditions, parameters, and external loads. This model is an eight-state-variable, nonlinear, time-dependent food chain model designed to simulate seasonal dynamics in Saginaw Bay, Lake Huron. The eight variables are phytoplanktons, herbivorous and carnivorous zooplankton, three chemical forms of N, and two chemical forms of P. Coefficients of variance during summer were similar to those measured.

Important parameters in terms of model sensitivity and variance propagation were identified for the variables for different times during the 350-day simulation. These included maximum phytoplankton specific growth rate, herbivorous zooplankton filter rate, carbon to chlorophyll ratio, and P to chlorophyll ratio. Parameter variance can be reduced in several ways: aggregating model state variables to reduce the number of uncertain parameters, acquiring additional laboratory and field data, limiting the range of true state variables aggregated as a single model state variable and characterized by assumed constant parameters, and reducing the variances associated with the most sensitive parameters. (Cassar-FRC)
W82-01917

CALCULATION OF BRACHIONUS RUBENS PRODUCTION BY THE DIRECT METHOD AND BY EDMONDSON'S METHOD,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
G. L. Vasil'yeva, and N. P. Blokhina.
Hydrobiological Journal, Vol 16, No 3, p 22-26, 1980. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Rotifers, *Productivity, *Lakes, *Lake Baikal, Aquatic animals, Chlorella, Chlorophyta, Water analysis, Mathematical studies, Aquaculture, USSR.

A comparison was made between the calculation of the production of rotifers by Edmondson's method and direct calculations of the removed biomass, i.e., with direct calculations of production, with reference to the abundant rotifer species Brachionus rubens. Data was obtained in summers of 1973 and 1974 during the mass cultivation of the rotifer B. rubens as a fish feed at the Baikal Biological Station. The rotifers were reared in five concrete tanks in the open on the shore of Lake Baikal. Rotifers were fed on the alga Chlorella vulgaris. Poor development of the culture was noted in 1973, with an increase in the overall abundance of rotifers in 1974, especially an intensive increase in the number of juveniles. The effect of water temperature on the duration of the individual development of rotifers was manifested fairly clearly. The temporal variations in the production of rotifers as calculated by the Edmondson method are in full agreement with those obtained by calculating the biomass, with a few exceptions. Production calculated by Edmondson's method was compared with directly recorded production. In these findings, the recording of production by the direct removal of biomass is fairly accurate. All that is not allowed for is elimination. However, it is suggested that it might be possible that there was no elimination in the brief periods between removals of biomass. The figure for production yielded by Edmondson's method is fairly close to empirical data obtained by direct calculation. Thus the present method satisfactorily described the productivity of the rotifers. (Baker-FRC)
W82-01921

EFFECT OF THE LIMING OF INTENSIVELY EXPLOITED PONDS ON PHYTOPLANKTON DEVELOPMENT,
Akademiya Nauk URSR, Kiev. Inst. Hidobiologii.
N. N. Kharitonova, and L. V. Gorobets.
Hydrobiological Journal, Vol 16, No 4, p 35-39, 1980. 1 Fig, 2 Tab, 25 Ref.

Descriptors: *Reservoirs, *Phytoplankton, *Ponds, Aquaculture, Plankton, Nitrogen, Phosphorus, Fertilizers, Nutrients, *Lime, Ecological effects.

The effect of the liming of extensively exploited ponds on phytoplankton development was investigated during 1972-1973 in rearing ponds No. 13 and 14 of the 'Tsentral'nyy' unit of the Donets Fish Combine. The ponds had an area of 53.8 and 118 ha, respectively, a mean depth of 1.89 and 1.97 meters respectively, and were typified by weak water exchange, intensive development of phytoplankton, and the presence of a large amount of suspended organic matter, as a result of which the transparency of the water was low. Higher water plants were essentially absent. Stocking density ranged from 6100 to 8000 fish/ha. The ponds were treated with organic fertilizer in the early spring and with N-P fertilizers throughout the summer. Lime was applied manually from a boat at a rate of 71-147 kg/ha. Phytoplankton samples were taken before the addition of lime, and also on the 3rd, 6th, 9th, 12th and 15th days thereafter. The samples were taken and processed by the standard procedures. Liming caused a brief reduction in the abundance and biomass of algae. Cyanophyta and Protococcinea proved most sensitive to the application of lime, with Volvocineae, Conjugatae and Euglenophyta being less sensitive. The development of Bacillariophyta was not appreciably affected by liming, but on occassion their abundance and biomass increased after lime had been added. The application of lime led to a significant improvement in the hydrochemical regime of the ponds, for example increased oxygen content and reduced content of dissolved organic matter in the water. The N-P fertilizers must be used following liming at a rate of 100-200 kg/ha for more rapid and controlled development of the phytoplankton. (Baker-FRC)
W82-01923

THE HYDROFLORA OF URBAN PONDS AS AN INDEX OF THEIR SANITARY AND BIOLOGICAL STATE,
Kharkov Univ. (USSR).
A. M. Matviyenko, T. V. Dogadina, N. I. Il'chenko, R. I. Meshcheryakova, and O. V. Savvina.
Hydrobiological Journal, Vol 16, No 4, p 45-48, 1980. 1 Tab, 20 Ref.

Descriptors: *Ponds, *Water quality, *Algae, Acidity, Urban areas, Fungi, *Kharkov, USSR, Recreation facilities, Eutrophic lakes, Eutrophication, Taxonomy.

The hydroflora were investigated in six ponds over a period of 2 years in Kharkov. Pond 1 was produced by damming a ravine and is used for recreational purposes. Pond 2 is a river pond situated in a densely populated area of the city. Pond 3 developed in a sand quarry and is used as a pond park and sports center. Pond 4 was produced by damming gullies and ravines and is used for recreation. Pond 5 is an excavated pond located in a densely populated area and is used for recreation. Pond 6 is an excavated pond with a dam and embanked shores, used for recreation. In the investigation, 294 intraspecific algal taxa were found in the phytoplankton. The largest numbers of different species were found in ponds 1 and 6, 149 and 136, respectively; the largest numbers of species are from the Protococcophyceae and Cyanophyta. Protococcophyceae and Bacillariophyta predominate in the phytoplankton of the ponds studied. Some rare species were also found, such as Ilsteria lobata, never reported before in the USSR. Ponds 1 and 4 were classified as moderately eutrophic, ponds 2 and 6 as strongly eutrophic, and pond 5 as eutrophic-polytrophic. Pond 3 was shown to be oligotrophic. The distribution of aquatic fungi showed the number of species to be poor, with ponds 1, 5 and 6 containing 18, 19, and 19 species, respectively. The oxygen content of the ponds was satisfactory. Permanganate oxidizability varied considerably. The pH was almost always low, 4.8-6.3. The phosphate content of the water ranged from 0.1 to 0.3 mg/l. (Baker-FRC)
W82-01924

CONTOURITES IN LAKE SUPERIOR,
Minnesota Univ., Minneapolis. Dept. of Geology and Geophysics.
T. C. Johnson, T. W. Carlson, and J. E. Evans.
Geology, Vol 8, No 9, p 437-441, September, 1980. 6 Fig, 27 Ref.

Descriptors: *Contours, *Lakes, *Bottom currents, Lake sediments, Lake morphology, Water currents, Bottom sediments, *Lake Superior, Seismology.

Preliminary evidence is presented for the existence of contourites in Lake Superior. The lake floor underlying the Keweenaw Current was traversed with a 3.5 kHz seismic-reflection profiling system on five cruises. Sediment samples were also obtained. The seismic reflection profiles observed can be attributed to turbidity currents or to contour currents. The geometry of the acoustic bed forms gives strong support for contour currents, as there are distinct wavy reflectors in a scoured trough at a depth of 200 m at the base of the trough. Hyperbolic echoes are found adjacent to the trough, and overlapping echoes farther lakeward. Sediment cores contained what appeared to be contours. There were irregular, thin sand layers with sharp upper and lower contacts, interbedded with sandy clay. This is the first report of marine-like contours in a lacustrine environment. (Small-FRC)
W82-01935

ZOOPLANKTON SPECIES DIVERSITY IN LAKE ST. CLAIR, ONTARIO, CANADA,
Windsor Univ. (Ontario). Dept. of Biology.
For primary bibliographic entry see Field 5C.
W82-01937

PHYTOPLANKTON ACCUMULATION IN LANGMUIR CELLS,
British Columbia Univ., Vancouver. Dept. of Mathematics.
G. T. Evans, and F. J. R. Taylor.
Limnology and Oceanography, Vol 25, No 5, p 840-845, September, 1980. 3 Fig, 17 Ref.

Descriptors: *Phytoplankton, *Langmuir cells, *Water circulation, Lakes, *Red tide, Dinoflagellates, Eutrophication, Wind.

The distribution of phytoplankton in Langmuir circulations is examined. In this case downwind transport is ignored, and only movement in a vertical cross section perpendicular to the axis is considered. The cell is 10 meters wide, and has a surface speed of 1.5 cm per sec, typical of that occurring with a 5 meter per sec wind. The water movement appeared to be relatively unimportant compared with the phytoplankton movement. Stommel's model (1949) is not applicable when phytoplankton velocities are not constant. The accumulation of phytoplankton by Langmuir cells depends greatly on the starting position of the organisms and on their vertical movement patterns. In red tides, the bloom from organisms will be swept into rows if they are on the surface when the Langmuir circulation starts. If the algae are below the surface, they may either be swept to the surface or not enter the circulation, depending on their depth. Those organisms in the center of the cell may remain below the surface, where they are not evident. (Cassar-FRC)
W82-01946

EFFECTS OF THERMOCLINE DISPLACEMENT UPON SUBSURFACE CHLOROPHYLL MAXIMA IN LAKE MICHIGAN,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. A. Bowers.
Journal of Great Lakes Research, Vol 6, No 4, p 367-370, 1980. 3 Fig, 15 Ref.

Descriptors: *Chlorophyll, *Thermocline, Lakes, *Lake Michigan, Thermal stratification, Wind.

Distinct subsurface maxima in the vertical distribution of chlorophyll have been observed in Lake Michigan during thermal stratification. This study determined that the depths of these maxima were significantly correlated with thermocline displacements from equilibrium in the nearshore areas. These water movements are a response to wind. During relatively calm periods in 1975 a distinct deep chlorophyll layer was present. In 1976 the periodic wind stress from the north and northeast created downwelling. The resulting deeper, less distinct thermocline decreased light intensity and increased turbulence, thus decreasing algal productivity and biomass. (Cassar-FRC)
W82-01957

SOUTHERN LAKE MICHIGAN SEDIMENTS: CHANGES IN ACCUMULATION RATE, MINERALOGY, AND ORGANIC CONTENT,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.

For primary bibliographic entry see Field 2J.
W82-01958

INORGANIC CHEMISTRY OF PARTICULATE MATTER FROM THE NEARSHORE ZONE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes and Marine Waters Center.
R. Rossmann.
Journal of Great Lakes Research, Vol 6, No 4, p 348-352, 1980. 5 Tab, 16 Ref.

Descriptors: *Particulate matter, *Trace metals, *Sinks, Lakes, Chemical precipitation, *Lake Michigan, Suspended sediments, Sediments, Lake sediments, Phytoplankton, Zooplankton, Metals, Heavy metals, Hypolimnion, Epilimnion, Calcium carbonate, Manganese oxides, Dolomite.

Suspended particulate matter collected near the Donald C. Cook Nuclear Plant, Lake Michigan, during 1974 through 1976 contained major amounts of trace metals relative to the soluble fraction. This particulate matter serves as a sink and a conveyor of trace metals to the sediments. Fe, K, Mg, and Mn were always more concentrated in the hypolimnion than in the epilimnion, and Ca, Cr, Cu, Na, Sr, Zn, and total P were almost always more concentrated in the hypolimnion than in the epilimnion. Sediment resuspension was the cause of this hypolimnion enrichment. Plankton were not significantly involved in trace metal particulate chemistry. Ratios of metals concentrations in phytoplankton:particulates and zooplankton:particulates did not exceed 0.058, whereas metals ratios in particulates:solubles were as high as 16 (Mn). Although calcium carbonate precipitated during the summer months, peaking in September, it is not important in this nearshore region as a P or trace metal sink because resuspension occurs regularly and river output is continuous. The substances most strongly correlated with trace metals were dolomite and hydrated Mn oxides, and possibly an organic substance of unknown composition. (Cassar-FRC)
W82-01959

THE POPULATION ECOLOGY OF IRON BACTERIA (GENUS OCHROBIUM) IN A STRATIFIED EUTROPHIC LAKE,
Freshwater Biological Association, Cumbria (England). Windermere Lab.
J. G. Jones.
Journal of General Microbiology, Vol 125, No 3, p 85-93, 1981. 8 Fig, 2 Tab, 34 Ref.

Descriptors: *Bacteria, *Eutrophication, Lakes, Population dynamics, Stratification, Seasonal variation, Iron, *England, English Lake District.

The present study examined the population ecology of Ochrobium sp. to determine the depth at which the organism grew in a eutrophic lake. Samples were taken over the deepest point of Esthwaite Water, a eutrophic lake with a surface area of 1 square kilometer and a mean depth of 6.4 meters. The hypolimnion of the lake becomes deoxygenated during summer stratification. At the onset of summer stratification in Esthwaite Water the release and immediate oxidation of ferrous ions from the sediment increased the turbidity in the overlying water. Ochrobium sp. capsules and Leptothrix sp. filaments were found in the turbid zone; their presence suggested either growth in situ or an upward migration from the sediment. Within a month the zone of iron oxidation and the Ochrobium sp. and Leptothrix sp. populations had moved upward into the water column, and peaks were found at depths of 12 to 13 meters. Turbidity profiles indicate the depth at which ferrous ions are oxidized and thus the depth to which oxygen must penetrate periodically. Within a week the hypolimnion had become deoxygenated further, carbon dioxide concentrations had increased, and the zone of iron oxidation had developed a sharp peak. The Leptothrix sp. and Ochrobium sp. had increased by an order of magnitude and were now separated into two distinct zones, the former above and the latter just below the peak of oxidized iron. During the period of most rapid growth it appeared that the generation time for Ochrobium sp. was 29 hr, but this did not allow for losses due to grazing and population migration. Later in the season wind-induced turbulence dispersed the zone of iron oxidation and the population of Ochrobium sp. The population overwintered in the sediment. (Baker-FRC)
W82-01997

ABUNDANCE DYNAMICS OF MICROORGANISMS IN THE DECOMPOSITION OF MACROPHYTES,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
V. M. Kudryavtsev, and Yu. V. Yeshov.
Hydrobiological Journal, Vol 16, No 4, p 14-18, 1980. 4 Tab, 7 Ref.

Descriptors: *Decomposition, *Macrophytes, *Microorganisms, *Bacteria, Organic matter, Nutrients, Temperature effects, Acidity, Aquatic plant, Banks, Vegetation, Water quality, Fungi, Reservoirs, Decomposing organic matter, Rybinsk Reservoir, USSR.

The dynamics of the development of microorganisms were observed during the death and decomposition of higher water plants under laboratory conditions. Experiments were conducted in 10-liter capacity glass aquaria filled with water from the bank areas of Rybinsk reservoir, which are overgrown with water plants. Also added were 10 g of wet biomass of water-lily, pondweed and bulrush. The plants were collected at periods of intensive growth. Samples were taken at fixed intervals from these containers for determination of the total number of bacteria on Synpor membrane filters by Razumov's method. During the observation period the temperature of the water varied only slightly, and the pH varied in the range of 7.35-8.25. Oxygen saturation of the water was 75-90%. The observations revealed that the total quantity of bacteria fluctuates appreciably in the decomposition of higher water plants. The abundance of bacteria in the experimental aquaria was 1.5-2.5 times greater than in the control. Intensive reproduction of bacteria was noted at the start of the experiment. Their highest abundance was recorded on day 3. Subsequently the rate of reproduction was affected by a number of factors, including temperature, illumination, and nutrient concentration. The abundance of bacteria was not the same in the decomposition of different species of macrophytes. The largest quantity was recorded in the decomposition of pondweed and water-lily, the least in the decomposition of bulrush. The readily decomposable part of the organic matter was oxidized by the saprophytic microflora. The bacteria noted were mainly nonsporulating. Consequently, the bacteria that decompose starch and cellulose are involved in utilization of organic matter of macrophytes along with microscopic fungi, the abundance of which ranged between a few tens and hundreds of thousands of cells milliliter. (Baker-FRC)
W82-01999

QUANTIFICATION OF THE LAKE TROPHIC TYPOLOGIES OF NAUMANN (SURFACE QUALITY) AND THIENEMANN (OXYGEN) WITH SPECIAL REFERENCE TO THE GREAT LAKES,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. C. Chapra, and H. F. H. Dobson.
Journal of Great Lakes Research, Vol 7, No 2, p 182-193, 1981. 4 Fig, 6 Tab, 38 Ref.

Descriptors: *Trophic level, *Lakes, *Oxygen depletion, Water quality, Mathematical studies, *Great Lakes.

Oxygen deficit of the Great Lakes is studied as a fundamental measure of the lake trophic state. Naumann's concept focuses on visual symptoms of eutrophication related to plant production in the lake's surface area. Thienemann's concept focuses on the oxygen concentration in deep waters. An attempt is made to express these two concepts on a common dimensionless scale in order to allow comparison of their relative importance in different parts of the lakes. Separate trophic scales and indices were developed; the scales are comparable, as they are expressed in a dimensionless form with a lower bound of zero and a mesotrophic range of 5 to 10. Using these scales, Lakes Superior, Huron, and Michigan were classified as oligotrophic. In terms of surface water quality, central and eastern Lake Erie and Lake Ontario were classified as mesotrophic, but on the oxygen scale they ranged from eutrophic in central Lake Erie to oligotrophic in Lake Ontario. For lakes of similar primary production, areal oxygen depletion is directly proportional to hypolimnion thickness. (Small-FRC)
W82-02004

COMPARATIVE LIMNOLOGY OF INNER LONG POINT BAY, LAKE ERIE, AND ADJACENT WATERS OF THE OUTER BAY,
Ontario Ministry of Natural Resources, Wheatley. Lake Erie Fisheries Research Station.
For primary bibliographic entry see Field 5B.
W82-02005

NITRATE ACCUMULATION IN AEROBIC HYPOLIMNIA: RELATIVE IMPORTANCE OF BENTHIC AND PLANKTONIC NITRIFIERS IN AN OLIGOTROPHIC LAKE,
Scientific and Industrial Research, Taupo (New Zealand). Freshwater Section.
W. F. Vincent, and M. T. Downes.
Applied and Environmental Microbiology, Vol 42, No 4, p 565-573, October, 1981. 6 Fig, 4 Tab, 35 Ref.

Descriptors: *Oligotrophic lakes, *Nitrates, Accumulation, Lakes, Benthos, Plankton, *Nitrification, Hypolimnion, Thermal stratification, Stratification, *Lake Taupo, *New Zealand.

The rate of accumulation of nitrate-nitrogen and the nitrification intermediate, nitrous oxide, was determined in the well-oxygenated hypolimnion of the largest oligotrophic lake in New Zealand. An examination of the vertical distribution of nitrifying bacteria was made by short-term radioisotopic assay to establish the relative contribution of benthic and planktonic species to the observed deepwater accumulation of oxidized nitrogen. The lake under study was Lake Taupo, a moderately large, deep, oligotrophic lake in the central volcanic plateau of North Island, New Zealand. Both nitrate and nitrous oxide accumulated in the hypolimnion of the lake throughout stratification. The two forms of oxidized nitrogen increased in concentration with increasing depth toward the sediments, where the concentrations of dissolved reduced nitrogen were two orders of magnitude higher than concentrations in the overlying water. Nitrification rates were measured by dark C-14 labeled carbon dioxide assays with and without the inhibitor nitrapyrin. The fastest rates were recorded for planktonic nitrifiers in the epilimnion and benthic species in the surficial 2.5 mm of the sediments. Nitrifying bacteria were least active in the deep hypolimnion. Deepwater accumulation of nitrate in Lake Taupo must therefore be a product of benthic rather than planktonic nitrification. (Baker-FRC)
W82-02023

EFFECT OF DIFFERENT WATER SALINITY LEVELS AND ORGANIC MATTER APPLICATION ON THE COMPOSITION OF WATER SOLUBLE AND EXCHANGEABLE BASES IN A BRACKISHWATER FISH POND SOIL,
Central Inland Fisheries Research Inst., Barrackpore (India).
G. N. Chattopadhyay, and L. N. Mandal.
Hydrobiologia, Vol 74, No 1, p 33-37, September, 1980. 3 Fig, 13 Ref.

Descriptors: *Fish ponds, *Organic matter, *Salinity, *Brackish water, ponds, Bases, Manure, Aquaculture, *Water pollution effects, Sodium, Potassium, Calcium, Magnesium, Soils, Nutrients.

Behavior of different water soluble and exchangeable bases in brackish water fish pond soil under different water salinity levels (0 to 30 ppt) in the presence and absence of added organic matter

were studied. Results indicated that the higher water salinity levels could adversely affect biological production of the ponds by increasing the amount of water soluble and exchangeable Na(+) (1.6 milliequivalent (me) per 100 g at trace salinity to 3.9-5.5 me per 100 g at 30 ppt salinity) and decreasing Ca(2+) (15.8-16.9 me per 100 g at trace salinity to 10.6 me per 100 g at 30 ppt salinity). Mg(2+) levels did not show a distinct relationship with water salinity without added organic matter. However, with organic matter, the Mg(2+) content increased from 11.7 me per 100 g at trace salinity to 14.6 me per 100 g at 30 ppt salinity. Application of organic manures was beneficial, increasing the exchangeable Ca(? +) and decreasing the exchangeable Na(+) in the soil. K(+) content was unaffected by organic matter treatment. SAR values of waters increased with increases in water salinity and decreased slightly on organic matter treatment. (Cassar-FRC)
W82-02027

A CONTROL MECHANISM OF THE PHYTOPLANKTON RESPIRATION IN A EUTROPHIC RESERVOIR,
Technische Univ., Dresden (German D.R.). Bereich Hydrobiologie.
J. Benndorf.
Hydrobiologia, Vol 72, No 1/2, p 125-129, July, 1980. 3 Fig, 2 Tab, 14 Ref.

Descriptors: *Respiration, *Photosynthesis, *Phytoplankton, *Carbon dioxide, Lakes, Reservoirs, *Eutrophic lakes, Bautzen Reservoir, Light intensity, Compensation light intensity, Bautzen Reservoir, Germany.

Water samples taken in the eutrophic Bautzen Reservoir, German Democratic Republic, between June 1976 and December 1978 had very low or non-existent free carbon dioxide on several sampling occasions when water temperatures were above 15 C, the incident light exceeded 500 J per sq cm per day, and there was no wind-induced agitation. The compensation light intensities (where photosynthesis equals respiration of the phytoplankton) were also very low, less than 0.2 J per sq cm per day, in the absence of CO2. The compensation light intensity increased with increasing concentrations of CO2. This result is interpreted as a minimizing of cell respiration at a low CO2 supply. Consequences of this control mechanism are high phytoplankton growth rates even at CO2 limitation during the light hours, storage of polyphosphates and possibly a high dark CO2 assimilation during the night. This shows possible errors inherent in the measurement of gross photosynthesis by the light-dark bottle technique and the calculation of the gross and net photosynthesis from the direct, continuous measurement of oxygen at low CO2 supply. (Cassar-FRC)
W82-02030

SEASONAL AND DIURNAL CHANGES OF CHLOROPHYLL IN A TROPICAL FRESH WATER IMPOUNDMENT,
Kamaraj Univ., Madurai (India). School of Biological Sciences.
V. Kannan, and S. V. Job.
Hydrobiologia, Vol 69, No 3, p 267-271, March, 1980. 1 Fig, 3 Tab, 21 Ref.

Descriptors: *Eutrophic lakes, *Phytoplankton, *Chlorophyll, Nutrients, Lakes, Seasonal variation, Diurnal distribution, Algae, Sathiar Reservoir, *India, Reservoirs.

The highly eutrophic Sathiar Reservoir, India, had a higher maximum production of chlorophyll a (37.16 + or - 3.93 micrograms per liter in July 1977) than any previously recorded in Indian waters. Minimum chlorophyll a was 2.2 + or - 0.61 micrograms per liter in September 1977, following the rains which caused dilution, outflow, and sedimentation with silt. Chlorophyll b fluctuated from 1.32 to 18.91 micrograms per liter. Daily chlorophyll levels were highest at 12 noon (occasionally at 3 p.m.) and minimum at 6 a.m. (Cassar-FRC)
W82-02052

EXPERIENCE WITH LAKE AND RESERVOIR RESTORATION TECHNIQUES IN THE GERMAN DEMOCRATIC REPUBLIC,
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
H. Klapper.
Hydrobiologia, Vol 72, No 1/2, p 31-41, July, 1980. 4 Fig, 2 Tab, 34 Ref.

Descriptors: Lake rehabilitation, *Eutrophic lakes, *Water resources management, Lakes, *Lake restoration, Water quality control, Water pollution prevention, *German Democratic Republic, Rehabilitation, Regulations, Fertilizers, Wastewater treatment, Nutrients, Hypolimnion, Aeration, Nitrogen compounds, Phosphorus compounds, Economic aspects, Social aspects, Phosphates, Reservoirs.

The intensive use of land and water resources has accelerated eutrophication of lakes in the German Democratic Republic. As of 1978, the total of 524 lakes have been classified as follows: 3.4% oligotrophic and mesotrophic, dimictic; 59.4% eutrophic; 29.6% polytrophic; and 9.6% hypertrophic. Several rehabilitation methods have been used in this country to prevent pollution and restore affected ecosystems. Government regulations control water use, establish protective zones, and specify fertilizer type and timing of applications. Sewage sludge and manures are extensively used as soil treatments, storage basins being provided for the winter months. Wastewater treatment removes nutrients by phosphate precipitation and denitrification. The water bodies themselves may be treated in situ by nutrient precipitation with aluminum sulfate, hypolimnetic depletion (withdrawing the nutrient-rich water for irrigation or drinking water), encouragement of desirable species of fish, increasing lake depth by damming, protection from light, covering sediments with inert material, changing flow patterns, desilting, aeration of surface or hypolimnion, addition of sodium nitrate to inhibit hydrogen sulfide formation, and controlling undesirable aquatic plants and animals. Improvements in both economic and social aspects resulted from these rehabilitation measures. (Cassars-FRC)
W82-02054

DISSOLVED OXYGEN DEPENDENT PHOSPHORUS RELEASE FROM PROFUNDAL SEDIMENTS OF LAKE CONSTANCE (OBERSEE),
Bayreuth Univ. (Germany, F.R.).
T. Frevert.
Hydrobiologia, Vol 74, No 1, p 17-28, September, 1980. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Phosphorus, *Dissolved oxygen, *Lake sediments, Sediments, Nutrients, Lake Constance, Path of pollutants.

Profundal sediments of Lake Constance did not release significant phosphorus as long as dissolved oxygen remained above 1 ppm and pH ranged between 7 and 8 in the overlying water. Experiments in perspex tubes using sediment-water systems from the lake also determined that the presence of a diatom sludge and carbonate-phosphate coprecipitate (CaCO3 + CaHPO4) increased the P release up to 0.5 mg per sq meters per day, an amount not significant to the P balance in this lake. The annual late summer increase of total P in profundal Lake Constance cannot be explained by P release from the sediment. It is more probable that P is accumulated from sinking of P-bound detritus of biogenic and/or tributary origin. (Cassar-FRC)
W82-02055

ENVIRONMENTAL STUDIES: THEIR IMPLICATIONS AND THE SPECIAL CASE OF EGYPT,
For primary bibliographic entry see Field 6G.
W82-02062

PHOSPHORUS CYCLING IN A DENSE POTAMOGETON PECTINATUS L. BED,
Rhodes Univ., Grahamstown (South Africa). Inst. for Freshwater Studies.
C. Howard-Williams, and B. R. Allanson.
Oecologia, Vol 49, No 1, p 56-66, 1981. 9 Fig, 6 Tab, 50 Ref.

Descriptors: *Cycling nutrients, *Lakes, *Phosphorus, Natural waters, Seasonal variation, Sago pondweed, Sediments, Benthic environment, Benthos, Nutrients, Aquatic plants, *Swartvlei Lake, *South Africa, Brackish water, Ogliotrophic lakes.

The dynamics of phosphorus concentration was studied in the littoral zone of Swartvlei, a southern African coastal lake. The implications of the nutrient pathways were examined in the regulation of phosphorus concentrations in the water. This brackish lake is oligotrophic and unpolluted, with an ionic composition the same as that of diluted sea water. Surface and bottom water samples were collected from two depth zones in the Potamogeton beds, at two-weekly or monthly intervals from 1975 to the end of 1978. The highest levels of phosphorus concentration were found in the sediment samples, with phosphorus concentration decreasing through above ground macrophytes, detritus, benthic invertebrates, below ground macrophyte tissue, epiphytic algae, water soluble phosphorus, and waterborne particulate phosphorus. The annual growth and decomposition patterns of Potamogeton were seen to control the seasonal variations in phosphorus concentrations in various groups. When the fate of a given input of phosphorus to the water was measured, 32% of it was found to be taken up by the large epihtyic algae, 17% by the Potamogeton, 16% by the benthic fauna, 28% by the sediments and 7% by microorganisms associated with detritus. A closed cycle of phosphorus movement was evident. When any phosphorus was released from decaying macrophytes, reabsorption rapidly occurred through the epiphytic algae. Once phosphorus has entered the cycling of the macrophyte community, it seems unlikely that it would ever enter into open circulation in the lake. (Baker-FRC)
W82-02070

ESTIMATION OF THE PRODUCTION OF PLANKTONIC INFUSORIANS IN CONNECTION WITH FLUCTUATIONS IN THEIR ABUNDANCE,
Gorkii State Univ. (USSR).
M. A. Kuznetsova, and T. P. Arslanova.
Hydrobiological Journal, Vol 16, No 3, p 15-21, 1980. 6 Fig, 4 Tab, 5 Ref.

Descriptors: *Plankton, *Productivity, *Ponds, *Population dynamics, Gorky Region, Lakes, Populations, Aquatic populations, Aquatic life, Biomass, Seasonal variation, *USSR.

The object of this study was to calculate the production of planktonic infusorians on the basis of daily observations of 5 and 10 days. In two separate water bodies daily measurements were taken of water temperature, the abundance of planktonic infusorians, their rate of reproduction, and the rate of their consumption. A small urban pond and Lake Velikoye were studied. The pond is in a forest park, and has an area of about 2 ha and a maximum depth of 1.5 meters. It is fed by springs and ground water. The planktonic infusorians of the pond are six species of Spirotricha: Halteria grandinella, Tintinndium fluviatile, Strombidium viride, Codonella cratera, Strombidium sp. and Strombilidium sp. The population quality of all species is characterized by a sudden increase and decrease within a period of several days. The duration of reproduction periods for all species of infusoria was comparable to the duration of the latent periods for which populations of a specific species either disappeared completely or were severely depressed in quantity. The temperature of the water was one of the major factors regulating infusoria quantity fluctuations. The production of infusoria obtained as a result of daily observations was about twice as low as the production found in ten-day intervals. (Baker-FRC)
W82-02072

EFFECT OF FERTILIZERS ON THE PRIMARY AND BACTERIAL PRODUCTION OF REARING PONDS IN THE VOLGA DELTA,

Kaspiiskii Nauchno-Issledovatelskii Inst. Rybnogo Khozyaistva, Astrakhan (USSR).
V. I. Vorob'yev, and A. F. Sokol'skiy.
Hydrobiological Journal, Vol 16, No 3, p 27-31, 1980. 5 Tab, 11 Ref.

Descriptors: *Fertilizers, *Ponds, *Aquatic life, *Aquaculture, Nitrogen, Phosphorus, Nutrients, Minerals, Fish, *Fish farming, *Volga Delta, USSR.

Model experiments were carried out at the Volga experimental plant of the Caspian Fisheries Research Institute to determine the effect of organo-mineral micronutrient fertilizers on the productivity of the ponds of this group. These experiments enabled an assessment to be made of the effectiveness of the different types of fertilizers on primary and bacterial production, and also on the chemical composition of the water of these ponds. Five experimental rearing ponds were used, each having an area of 0.65-2.0 ha and a mean depth of about one meter. Ammonium nitrate and superphosphate were added to pond No. 21 at a rate of 12 kg/ha. Reeds cut and prepared 2 years earlier were added to pond No. 22. The reeds had already spent one season in the water as fertilizer, but because they had been only 40-50% mineralized in that season, they had been left for another year. N and P mineral fertilizers were also added to this pond, each at a rate of 12 kg/ha. Superphosphate and ammonium nitrate were added to pond No. 23 at 12 kg/ha, and cobalt chloride was also added at a rate of 2 kg/ha over the season. Only superphosphate at 12 kg/ha was added to ponds No. 15 and 40, along with cobalt chloride at 2 and 5 kg/ha, respectively, over the season. The findings yielded the conclusion that the use of cobalt in the rearing ponds and elsewhere in the case of cobalt deficits makes it possible to create more favorable abiotic conditions in the water, to practically double the rate of bioproductive processes, and to involve other trace elements in the biological cycle. (Baker-FRC)
W82-02077

PHYTOPLANKTON DISTRIBUTION IN THE SOUTHERN AND MIDDLE PARTS OF LAKE BAIKAL,
Akademiya Nauk SSSR, Novosibirsk. Inst. Fiziki.
N. A. Frank, L. A. Shchur, A. D. Aponasenko, and F. Ya. Sid'ko.
Hydrobiological Journal, Vol 16, No 3, p 13-15, 1980. 2 Fig, 7 Ref.

Descriptors: *Lakes, *Phytoplankton, Distribution, Vertical distribution, Spatial distribution, *Lake Baikal, Chlorophyll, Biomass, USSR, Chlorophyll a.

Hydrobiological and hydrooptical research was carried out in July of 1974 in the southern and middle parts of Lake Baikal between Slyudyanka settlement and the Ol'khonskiye Vorota strait with the objective of determining the abundance and biomass of the phytoplankton, its chlorophyll a content, the characteristics of the attenuation of the water and other hydrooptical characteristics. A total of 44 sampling sites were chosen. Chlorophyll content in the surface zone of the water at a depth of 1 meter in the southern part of Lake Baikal as far as Cape Kadil'nyy ranged between 0.1 mg/cubic meter and 0.3 mg/cubic meter, and the abundance and biomass of the phytoplankton were respectively 3000 to 40000 cells/liter and 12-40 mg/cubic meter. Chlorophyll content 1 km from the shore of the lake is on the average 1 to 1/5 times the content in the central part of the lake. The vertical distribution of chlorophyll has a clear maximum at a depth of 5 to 10 meters. Investigations around the mouth of the Solzan River did not reveal appreciable differences in the vertical and horizontal distribution of chlorophyll a from the values characteristic for the southern part of Lake Baikal. The drift of the Selenga River had an appreciable effect on phytoplankton distribution in the middle part of Lake Baikal. (Baker-FRC)
W82-02078

FINDS OF RELICT INFUSORIA IN KIEV RESERVOIR,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. A. Koval'chuk.
Hydrobiological Journal, Vol 16, No 4, p 27-31, 1980. 7 Fig, 17 Ref.

Descriptors: *Reservoirs, *Plankton, Benthos, Infusoria, Protozoa, Aquatic life, *Halophytes, *Kiev Reservoir, Salt tolerance, Reservoir stages, USSR.

A number of halophilous forms which were discovered during an investigation of the benthic Infusoria of Kiev reservoir in 1977-1978 are described. Forms found included: Prorodon marinus, Lacrymaria caudata, Lagynurus pumilio, Frontonia aberrans, Cyclidium helgolandicum, Cristigera minuta, Lohmanniella elegans, Metopus vestitus, and Condylostoma remanei. All the relict forms of Infusoria were found in a small area round the village of Strakholes'ye above Teterev Bay, where marshes in which conditions are favorable to the existence of these infusorians existed before the filling of the reservoir. The species composition of the relict forms was most varied in the autumn in the psammon, and also in bulrushes, apparently in connection with the resistance of individual populations of this plant to salinification. The fact that there is a predominance of the boreal element in the relicts suggests an incursion of waters from the Baltic into the Black Sea during one of the transgressions. During the period of their existence in isolation, the relict infusorians of Kiev Reservoir have changed relatively little, and it is therefore concluded that the isolation has not been lengthy. (Baker-FRC)
W82-02079

THE PREDICTED CONTENT OF ORGANIC AND BIOGENIC MATTER IN THE WATER OF VILYUY RESERVOIR AND THE EXTENT TO WHICH IT HAS BEEN CONFIRMED,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
T. M. Labutina, and A. I. Denisova.
Hydrobiological Journal, Vol 16, No 4, p 77-80, 1980. 2 Tab, 6 Ref.

Descriptors: *Reservoirs, *Organic matter, *Permafrost, Prediction, Decomposing organic matter, *Vilyuy Reservoir, Vegetation, Water quality, Water pollution sources. USSR.

The Vilyuy reservoir lies in the northeast of the country in a permafrost region. The reservoir was formed in southwestern Yakutia by the damming of the Vilyuy River 21 km below the mouth of the Akhtaranda River. When the reservoir was filled, 30,000,000 cubic meters of forest were inundated. For several years the submerged tree trunks were the source of various chemicals that found their way into the water. The submerged vegetation and soils have appreciably influenced water quality in the reservoir and the content of organic and biogenic matter. Long-term records on the seasonal content of organic and biogenic matter in the water of Vilyuy River and its affluents were used to analyze and predict the expected concentrations of organic and biogenic matter during the period of 1969-1975 in the waters of the reservoir. When the predicted and the actual concentrations were compared, it was found that the deviations of the former from the latter did not exceed plus or minus 8%. River discharge was the main factor in the formation of the hydrochemical regime of the reservoir. Arboreal vegetation took second place, and soils took third. (Baker-FRC)
W82-02080

BACTERIOPLANKTON AND PHYTOPLANKTON IN THE KIEV SECTOR OF KANEV RESERVOIR DURING THE PERIOD OF ITS FORMATION,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Gavrishova, and L. N. Chernitskaya.
Hydrobiological Journal, Vol 16, No 4, p 6-14, 1980. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Reservoirs, *Phytoplankton, *Bacteria, Water quality, Self-purification, Algae, Plankton, *Kanev Reservoir, Reservoir stages, Water pollution sources, USSR.

The hydrobiological regime of the Kiev sector of Kanev reservoir was investigated during the period of its creation via microbiological indices and phytoplankton. In 1975, which was the fourth year of filling, the highest bacteriological indices occurred. This year was characterized by extreme temperature and hydrologic features. From 1975-1977, the bacteriological indices increased relative to the data obtained in 1972-1974. This is in agreement with the trend toward an increase in the abundance of bacterioplankton during the first years of the creation of a reservoir. During this period of time a gradual increase was noted in algal biomass, and an increase was also seen in the number of algal species, due to the conversion of the sector to a reservoir. In spite of alterations in the ratio and abundance of the algae, the dominant composition of the main groups was maintained. Using data from an analysis of the distribution of the abundance of bacterioplankton and phytoplankton at different points in the Kiev sector of the reservoir, a rank estimate was prepared of water quality. The rank indices of the water at the beginning, in the middle and at the end of the sector ranged between 4 and 6 in the classification of Zhukinskiy. This finding suggests that the capacity of the water in the Kiev sector of the reservoir to undergo self-purification declined slightly after the filling of the Kanev reservoir. (Baker-FRC)
W82-02081

PLANKTONIC INFUSORIA OF KIEV AND KREMENCHUG RESERVOIRS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
A. A. Nebrat.
Hydrobiological Journal, Vol 16, No 4, p 23-27, 1980. 16 Ref.

Descriptors: *Reservoirs, *Plankton, *Protozoa, Productivity, Lake ice, Infusoria, Ukraine, Seasonal variation, Temperature effects, Stagnant water, *Kiev Reservoir, *Kremenchug Reservoir, USSR.

The study of planktonic infusoria of Kiev and Kremenchug reservoirs began in the spring of 1972 and continued until autumn of 1975. A total of 110 species of infusoria were identified in the plankton from these two reservoirs, of which 85 were new for the Dnieper and its reservoirs, and 29 for the Ukraine. Holotricha were the most richly represented in the reservoirs investigated with 60 species or 54.5%, followed by Spirotricha with 40 species or 35.7%, and Peritricha for 11 species or 9.8%. The species were identified during seasonal excursions and showed wide variations with the seasons. In terms of abundance, T. fluviatile took first place among the dominant species of Infusoria in the pelagic zone of Kremenchug reservoir at 41.8% of total abundance. The highest population density of this species was recorded in the lower part of the reservoir at 50.3%. Small Spirotricha typical of stagnant and bog waters were dominant during the spring months in the shallow upper parts of the Kremenchug reservoir. A total of 45 species were found in the reservoirs in the autumn. The number of species of infusoria remaining below the ice in water bodies was very small and their abundance at this time of the year is low. (Baker-FRC)
W82-02082

INVESTIGATION OF TURBULENCE AND LANGMUIR CIRCULATION IN LAKE LADOGA,
Akademiya Nauk SSSR, Leningrad. Inst. of Lake Studies.
N. N. Filatov, S. V. Rjanzhin, and L. V. Zaycev.
Journal of Great Lakes Research, Vol 7, No 1, p 1-6, 1981. 5 Fig, 19 Ref.

Descriptors: *Water circulation, *Lakes, *Russia, Turbulence, Water currents, *Ladoga Lake.

Experimental measurements were taken of currents in the gulf of the northeast part of the nearshore zone of Lake Ladoga, USSR. Horizontal measurements were carried out at a 5 meter depth for 3 months. Measurements were also made of current fluctuations, both horizontal and vertical. Kinetic

energy spectra and the corresponding linear invariant spectra of currents calculated from measurements at a 10 meter depth in the offshore zone of the lake for a wide range of frequencies showed several maxima which corresponded to the following events: synoptic oscillations of currents with time scales of about 2 to 4 days, inertial oscillations of 13 to 14 hr periods, Langmuir circulation with time scales of 5 to 10 minutes, micrometeorological oscillations with a time scale of 1 minute, and oscillation with the periods of surface waves in the upper layer. From the measurements of vertical fluctuations, horizontal fluctuations, and gradients of mean speed of currents, coefficients of vertical turbulent exchange were determined. The dependencies of mean vertical current speed and depths of penetration of Langmuir circulations as a function of wind speed and stratification were calculated. The calculated relations were not linear. (Baker-FRC)
W82-02100

2I. Water In Plants

EFFECT OF PERIODS OF MOISTURE AVAILABILITY ON GROUNDNUT CROP IN THE SAURASHTRA REGION OF GUJARAT,

Bansilal Amritlal Coll. of Agriculture, Anand (India).
For primary bibliographic entry see Field 2G.
W82-01708

SOIL WATER STUDIES ON SMALL LUCERNE PLOTS,

Department of Agriculture and Fisheries, Stellenbosch (South Africa).
D. J. Beukes, and H. W. Weber.
Water SA, Vol 7, No 3, p 166-174, July, 1981. 4 Fig, 4 Tab, 18 Ref.

Descriptors: *Hay, *Soil water, *Soil-water-plant relationships, Irrigation effects, Crop yield, Crop production, Water use efficiency, Agriculture, Alfalfa, *South Africa.

Lucerne was grown in the field under four soil water depletion (SWD) levels; 15%, 35%, 55%, and 75%. The primary objective of this investigation was to determine the finer details of methods and instruments for measuring soil water, but the present paper discussed the secondary objectives: to determine the changes in soil water content and soil water pressure as well as the water use characteristics of lucerne. Irrigation requirements were established of 1100 mm for a 15% SWD and 700 mm for a 75% SWD. There was a direct relationship between the soil water regime and the amount of water consumed. With a 15% SWD level the rate of evapotranspiration equaled that of pan evaporation. Changes in soil water content and soil water pressure occurred on a much shallower level with a 15% than with a 75% SWD. When there was a decrease in the SWD level, there was an increase in the growth rate of lucerne, a decrease in the water use efficiency, and an increase in hay production. (Small-FRC)
W82-01713

ECOLOGICAL AND PHYSIOLOGICAL FEATURES OF THE ROOT SYSTEM OF INSHORE HYDROPHYTES,

Ukrainian Academy of Sciences, Kiev (USSR). Institute of Hydrobiology.
For primary bibliographic entry see Field 5B.
W82-01715

THE EFFECT OF DIFFERENT WATER REGIMES ON PLANT GROWTH AND NODULE STRUCTURE OF GREENHOUSE-GROWN WINGED BEAN (PSOPHOCARPUS TETRAGONOLOBUS),

University of West Indies, Kingston (Jamaica). Dept. of Botany.
E. L. Rathfelder.
Annals of Applied Biology, Vol 98, No 1, p 143-148, May, 1981. 4 Fig, 23 Ref.

Descriptors: *Soil-water-plant relationships, *Water stress, *Root development, Beans, Waterlogging, Nodules, Greenhouses.

Three water regimes were applied to the potted seedlings of winged beans (Psophocarpus tetragonolobus cv. Chimbu Illinois) in a greenhouse: control (field capacity, 20% water by weight added each morning), stress (half of field capacity, 10% water by weight added each morning), and wet (pots standing in water to produce waterlogging in the bottom 1 cm). Root nodules did not form in the stressed plants until 4 weeks, compared with 3 weeks in the other treatments. Nodules were 54% smaller than those in control plants and 39% smaller than in waterlogged plants. These differences decreased with time. (Cassar-FRC)
W82-01723

NOTE ON THE ROLE OF IRRIGATION FREQUENCIES ON THE REGROWTH OF BERSEEM,

Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India).
A. Kumar, and S. D. Rai.
Indian Journal of Agricultural Sciences, Vol 51, No 3, p 194-196, March, 1981. 1 Fig, 1 Tab.

Descriptors: *Irrigation effects, *Crop production, *Soil water, Vegetation regrowth, Plant growth, Crop yield, Forages, *India.

The effect of soil moisture on the regeneration of berseem (Trifolium alexandrinum Juslen) was evaluated in a 1976-77 field study. Irrigation of the crop at a ten day interval was ideal for favorable growth and high yield of green fodder. Frequent watering may have helped the crop hydrolyze and mobilize the root carbohydrates. When irrigation frequency was reduced, the rate of regrowth was reduced. The rate of dry matter accumulation in the first ten days after cutting increased with the advancement of cuts. This effect was more conspicuous when irrigation frequencies were reduced. Thus, with frequent irrigation and a sufficiently high water table, berseem can continuously supply forage. The crop accumulated the highest dry matter/day during the first 10 days after cutting, regardless of the irrigation scheme used. (Small-FRC)
W82-01745

SIMULATION OF SOIL WATER WITHIN THE ROOT ZONE OF A CORN CROP,

Kentucky Univ., Lexington. Dept. of Agronomy.
For primary bibliographic entry see Field 2G.
W82-01834

EFFECT OF SOIL MOISTURE STRESS ON LEGUME-RHIZOBIUM SYMBIOSIS IN SOYBEANS,

Govind Ballabh Pant Univ. of Agriculture and Technology, Pantnagar (India). Dept. of Soil Science.
T. R. Rathore, P. K. Chhonkar, R. S. Sachan, and B. P. Ghildyal.
Plant and Soil, Vol 60, No 3, p 445-450, 1981. 3 Tab, 9 Ref.

Descriptors: *Water stress, *Soybeans, *Symbiosis, Soil-water-plant relationships, Legumes, Soil moisture deficiency.

Soybeans, cv. Hark, in pots were subjected to water stress (temporary wilting for 3 days) at each of several stages: nodule initiation (NIS), early flowering (EFS), midbloom (MBS), early flowering and midbloom (EFS + MBS), rapid pod filling, (RPS), and midbloom and rapid pod filling (MBS + RPS). Moisture stress did not affect nitrogen status of roots or number of bacteroids. However, leghemoglobin content, number and weight of pods per pot, number and weight of seeds per pot, and seed protein content were all affected to varying degrees by moisture stress at different stages. In general, moisture stress reduced leghemoglobin content of root nodules, N uptake, yield and seed protein content, and delayed flower initiation and plant maturity. Stress at the early stages only (NIS or EFS) allowed plants to recover and produce normal yields, but stress at later stages halved the yield. Stress at EFS + MBS and MBS + RPS was less harmful than either EFS or MBS deprivation alone, indicating an increased adaptability. (Cassar-FRC)
W82-01846

DOUBLE AND MONOCROPPED WHEAT AND GRAIN SORGHUM UNDER DIFFERENT TILLAGE AND ROW SPACINGS,

Oklahoma State Univ., Stillwater. Dept. of Agronomy.
R. J. Crabtree, and G. A. Makonnen.
Soil Science, Vol 132, No 3, p 213-219, September, 1981. 3 Fig, 4 Tab, 8 Ref.

Descriptors: Available water, *Agricultural engineering, Farming, Soil water, Resources management, Soil-water-plant relationships, Water resources development, *Wheat, *Sorghum, Crop yield, *Experimental farms, Oklahoma.

A field study was conducted on wheat double-cropped with grain sorghum under rain-fed conditions at the Oklahoma Vegetable Research Station at Bixby. The soil was a Wynona silt loam with 0 to 1% slope. The experiment ran from December 1975 to November 1979. The effects of tillage and row spacings on soil water content and yields of monocropped (MC) and double-cropped (DC) wheat and grain sorghum were studied. When planted at the same time and over a 4-year period, DC wheat yielded 2260 kg per ha, compared with 2890 for monocropped wheat. Drought produced a failure in the grain sorghum as the second crop for 1 of the 4 years. For the 3 years of successfully double-cropped grain sorghum with conventional tillage, the yield in 50 cm rows was 4080 kg/ha, compared with 3810 kg/ha in 75 cm rows. No-tillage, DC grain sorghum in 50 cm rows yielded 3830 compared with 3590 kg/ha in 75 cm rows. When planted at the same time as the DC grain sorghum with conventional tillage, MC grain sorghum in 50 cm rows yielded 4150 kg/ha, compared to 3760 kg/ha in 75 cm rows. For the DC treatments, water content in 120 cm of soil profile was not significantly affected by tillage and row spacings during the grain sorghum growing period. However, tillage and planting operations must be timely to prevent loss of water in the soil-seed environment when attempting to establish a stand for the double crop. On the average only 12% of the precipitation that fell from mid-June to early October for the 3 years of successful DC was detected as stored water in the MC wheat plots. More grain production and more effective use of annual precipitation and soil water were achieved in 3 out of the 4 years when wheat and grain sorghum were DC. (Baker-FRC)
W82-01862

CONTROL OF PEACH TREE GROWTH AND PRODUCTIVITY BY REGULATED WATER SUPPLY, TREE DENSITY, AND SUMMER PRUNING,

Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
D. J. Chalmers, P. D. Mitchell, and L. van Heek.
Journal of the American Society for Horticultural Science, Vol 106, No 3, p 307-312, May, 1981. 7 Tab, 19 Ref.

Descriptors: *Irrigation practices, *Crop yield, *Fruit crops, Irrigation, Water supply, Trickle irrigation, *Peaches, Irrigation efficiency, Growth rates.

Various methods were used to determine if they could be productive in controlling tree vigor and fruit production in ultra-dense peach orchards. Root competition, summer pruning, and regulated irrigation all inhibited tree growth, but regulated irrigation combined with root competition generated from high tree density was the most effective. Yields of fruit and growth of fruit were significantly increased up to 30% by high tree density combined with low rate of water application, when water stress limited shoot growth but stimulated subsequent fruit growth. The production of increased fruit yield while simultaneously reducing vegetative growth indicates that irrigation can be

used as a powerful management strategy to manipulate plant growth for greater fruitfulness in much the same manner as dwarfing rootstocks. These data do show that the effects intensified as root competition intensified at the closer spacing and also as the root system grew. Management treatments that concentrate the root system, such as controlled wetted zones as in trickle irrigation, natural barriers as in shallow soils, or even artificial barriers could be expected to increase the effectiveness of regulated irrigation. Increased yields with reduced irrigation will only be obtainable, however, for as long as the tree has excess vegetative vigor that can be suppressed in favor of fruit growth. As trees become older and lose their potential for vegetative growth, there will be less need to control them, and the harvest index will increase naturally. The irrigation strategy will be determined according to the natural vigor of the trees, the age of the planting, the soil type, the fruit growth, and the crop load. (Baker-FRC)
W82-01883

RESPONSES OF GRAIN SORGHUM TO VARIABLE WATER SUPPLY UNDER TWO IRRIGATION FREQUENCIES,
California Univ., Davis. Dept. of Land, Air, and Water Resources.
For primary bibliographic entry see Field 3F.
W82-01944

CORN AND ALFALFA PRODUCTION AS INFLUENCED BY LIMITED IRRIGATION,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
For primary bibliographic entry see Field 3F.
W82-01945

INFLUENCE OF TRICKLE AND SPRINKLE IRRIGATION ON GOLDEN DELICIOUS APPLE QUALITY,
Irrigated Agriculture Research and Extension Center, Prosser, WA.
For primary bibliographic entry see Field 3F.
W82-02001

EFFECT OF PROFILE SOIL MOISTURE AND PHOSPHORUS LEVELS ON THE GROWTH AND YIELD OF ANONUTRIENT UPTAKE BY CHICKPEA,
Haryana Agricultural Univ., Hissar (India).
S. Singh, and H. C. Sharma.
Indian Journal of Agricultural Sciences, Vol 50, No 12, p 943-947, December, 1980. 3 Tab, 7 Ref.

Descriptors: *Crop production, *Soil water, Crop yield, Chickpea, Nutrients, Nitrogen, Phosphorus, Water stress, Soil-water-plant relationships.

A field experiment was conducted in 1975-76 and 1976-77 with all combinations of three profile soil-moisture levels, 125, 160 and 200 mm/m, with and without 50 mm of additional irrigation water, allocated to main plots and four doses of phosphorus, 0, 4.5, 9.0, and 13.5 kg P/ha, in the subplots. A split plot design was used. Soils were sandy loam, low in organic carbon and available nitrogen, medium in phosphorus, and high in potassium. The pH of the soil was 7.8; maximum water retention capacity of the soil profile was 225 mm/m. In the 3rd, 4th, and 5th weeks of January the amount of rainfall received was 3.5, 2.6, and 10.0 mm, and in the 2nd and 3rd weeks of February it was 2.6 and 16.2 mm, respectively. Significant increases in dry matter accumulation owing to higher initial soil-moisture levels were recorded at all the stages of crop growth, although the yield increment became smaller with successive increases in soil profile moisture. The additional irrigation of 50 mm given 60 days after sowing further increased the dry matter, and to a greater extent at lower levels of soil profile moisture than at higher levels. Phosphorus application increased dry matter accumulation significantly at all growth stages. Higher moisture supply by building 200 mm of initial profile soil moisture supplemented with 50 mm of protective irrigation 60 days after planting the crop resulted in 71.5 and 31.3% increase in N and P uptake by chickpea crop over the lower level (125 mm) of soil moisture. (Baker-FRC)
W82-02042

EFFECT OF SOIL-MOISTURE TENSIONS AND PRECEDING WINTER CROPS ON THE YIELD AND WATER-USE EFFICIENCY OF SUCCEEDING CROP OF TOSSA JUTE,
Bidham Chandra Krishi Vishwa Vidyalaya, Kalyani (India).
H. Sen, P. K. Jana, and S. P. Maity.
Indian Journal of Agricultural Sciences, Vol 50, No 12, p 948-951, December, 1980. 1 Fig, 6 Tab, 5 Ref.

Descriptors: *Crop production, *Soil water, Water stress, Crop yield, Wheat, Potatoes, Mustard, Soil-water-plant relationships.

The influence of soil-moisture tension was investigated in sandy-loam soil on the fiber yield of tossa jute. In 1973 and 1974 the experiment was conducted with three soil-moisture tensions for each of the three winter crops, wheat at 0.3, 0.5, and 1.0 atm, mustard at 0.5, 1.5, and 2.5 atm, and potato at 0.3, 0.6, and 0.9 atm, and three soil moisture tensions at 0.3, 0.6, and 0.9 atm for jute. The higher yield of jute was associated with decreases in soil-moisture tension. The preceding winter crops and the maintenance of different soil-moisture tensions for each of these winter crops had no significant effect on fiber yield, stick yield, and height of the plant. The water use efficiency increased with an increase in soil-moisture tension. The yield and water use efficiency demonstrated that a maintenance of 0.6 atm tension was useful. (Baker-FRC)
W82-02045

TURNOVER OF TRITIATED WATER IN CALAMONDIN PLANTS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
For primary bibliographic entry see Field 5A.
W82-02048

2J. Erosion and Sedimentation

SEDIMENT-CONTAMINANT TRANSPORT MODEL,
Battelle Pacific Northwest Lab., Richland, WA.
For primary bibliographic entry see Field 5B.
W82-01614

TEMPORAL AND SPATIAL VARIATIONS OF MERCURY, LEAD, ZINC, AND COPPER IN SEDIMENTS OF THE SAGUENAY FJORD,
Laval Univ. (Quebec). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W82-01639

NOTE ON TWO LIMIT DISTRIBUTIONS OF BEDLOAD MOVEMENT,
Waikato Univ., Hamilton (New Zealand). Dept. of Earth Sciences.
W. E. Bardsley.
Journal of Hydrology, Vol 52, No 1-2, p 165-169, June, 1981. 9 Ref.

Descriptors: *Sediment transport, *Model studies, *Mathematical studies, *Bed load, Sediment load, Statistical methods, Channel erosion, Channel flow, Analysis of variance, Mathematical equations, Sediment erosion.

Many models of bedload transport described channel-floor particle movement in terms of a one-dimensional unidirectional random walk. The transported particles are assumed to experience a rest period, prior to each step, which is large in relation to the time spent in the next phase of movement. A case of bedload transport was considered where the step length and rest periods are identically distributed, yet independent random variables. In the model described, as time approaches infinity, the distance an arbitrary particle is transported is shown to be a normally distributed random variable. The mean and variance of this limit distribution may be obtained as simple functions of the mean and variance of the step lengths and rest periods. As the distance an arbitrary particle is transported approaches infinity, similar results are observed for the time it takes for the transport. (Geiger-FRC)
W82-01643

SPATIAL AND TEMPORAL VARIATIONS IN CESIUM-137 AND CARBON IN SEDIMENTS OF SAGUENAY FJORD (VARIATIONS SPATIALES ET TEMPORELLES DU CESIUM-137 ET DU CARBONE DANS DES SEDIMENTS DU FJORD DU SAGUENAY),
Laval Univ. (Quebec). Dept. of Chemistry.
C. Barbeau, R. Bougie, and J-E. Cote.
Canadian Journal of Earth Sciences, Vol 18, No 6, p 1004-1011, June, 1981. 4 Fig, 2 Tab, 15 Ref.

Descriptors: *Sedimentation rates, *Fjords, Cesium, *Cesium radioisotopes, Radioisotopes, Cores, Canada, Erosion, Sedimentation, Sediments, *Saguenay Fjord, Quebec.

Measurements were made of the rate of accumulation of sediments in the Saguenay Fjord, Quebec, Canada. The measurements were made from cesium-137 activity in 19 cores. The data varied between sediment rates of greater than 1.0 cm/year upstream and 0.2 cm per year downstream. In cores from the northern basin, the cesium-137 profiles indicate that they follow the pattern of fallouts on the ground, reflecting the impact of a sudden inflow of clay from a major mudslide. In large basins indications are that the rate of sedimentation is less influenced by external happenings. At upstream locations the carbon content and the C/N ratio are higher. Based on cesium-137 dating, core sections show carbon contents that reflect changes caused by the forest industry over the years. (Baker-FRC)
W82-01644

FIELD OBSERVATIONS OF THE ISOTOPIC COMPOSITION OF PARTICULATE ORGANIC CARBON IN THE SOUTHERN NORTH SEA AND ADJACENT ESTUARIES,
Institute for Soil Fertility, Groningen (Netherlands). Delft Hydraulic Lab.
W. Salomons, and W. G. Mook.
Marine Geology, Vol 41, No 3-4, p M11-M20, June, 1981. 3 Fig, 7 Tab, 14 Ref.

Descriptors: *Organic carbon, *Sediment transport, *Fluvial sediments, *Isotope studies, Organic matter, Sediment distribution, Soil erosion, Peat soils, Organic soils, Peat, Suspended sediments, Sediments, Mixing, Sedimentation, *Estuaries, North Sea.

The isotopic composition of the organic carbon in a large number of sediments from the southern North Sea and in fluvial and estuarine deposits was determined field tests. Organic matter in fluvial sediments and suspended matter was found to contain carbon isotopes in a range characteristic of continental organic matter (-25 to -28 o/oo). In sediments of marine sedimentation sites and in marine suspended matter, delta C13 values fluctuated between -20 and -25 o/oo. The low mean values of -13.2 o/oo for the deposited sediments indicated a high content of continental organic matter deposited from present-day rivers or from the erosion of peat layers from the terrestrial or marine environment. The source of detrital continental organic matter could not be ascertained by stable isotope studies. In the estuarines examined, the content of organic matter decreased and the delta C13 values increased in the seaward direction, probably as a result of the mixing of fluvial and marine sediments. (Geiger-FRC).
W82-01714

DISTRIBUTION, MORPHOLOGY, AND ORIGIN OF SEDIMENTARY FURROWS IN COHESIVE SEDIMENTS, SOUTHAMPTON WATER,
Institute of Oceanographic Sciences, Taunton (United Kingdom).
For primary bibliographic entry see Field 2L.
W82-01720

SEDIMENT TRANSPORT AND A RESERVOIR SITUATION FORMULA FOR ZIMBABWE-RHODESIA,
Rhodesia Univ., Salisbury. Dept. of Civil Engineering.
P. R. B. Ward.
Civil Engineer in South Africa, Vol 22, No 1, p 9-15, January, 1980. 11 Fig, 5 Tab, 21 Ref.

Descriptors: *Sediment transport, *Reservoir silting, *Rhodesia, Silt, Silting, Sedimentation, Suspended load, Rivers.

A three year experimental program to determine the amount of sediment transported by Rhodesian rivers is described. The findings are based on river measurements of sediment transported past hydrological gauging stations and not on measurements of reservoir siltation rates. The sediment yield depends on several factors, including rainfall, geology, land tenure and catchment slope. Measurements of suspended sediment concentrations in water samples were made by a turbidity method. Four or five samples from each sampling site, taken during flood flows, were analyzed for size distributions. A representative value for losses of suspended sediments from large catchments in Rhodesia is 38 t/sq km/year. Allowing an extra 10% loss by transport of dissolved solids, and the total loss from catchments is 42 t/sq km. This figure was in agreement with previously determined findings which had been based on reservoir siltation rates. However, this figure was several times smaller than data for small catchments under heavy human occupation in Tanzania.
W82-01736

CROP RESIDUE REMOVAL AND TILLAGE; EFFECTS ON SOIL EROSION AND NUTRIENT LOSS IN THE CORN BELT,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
M. J. Lindstrom, S. C. Gupta, C. A. Onstad, R. F. Holt, and W. E. Larson.
Agricultural Research Service, Agriculture Information Bulletin Number 442, October 1981. 35 p, 1 Fig, 13 Tab, 13 Ref.

Descriptors: *Cropland, *Nutrient removal, *Soil erosion, *Cultivation, Soil conservation, Biomass, Fuel, Corn belt, Crop yield, Productivity, Farm management.

Soil erosion is already a serious problem in the U. S., and if large amounts of crop residues are removed for use as biomass for fuels, soil erosion would be accelerated. The Universal Soil Loss Equation (USLE) was used to predict soil erosion for five residue and tillage management systems, and the amounts of residue that could be removed without undue damage to the soil. Crop acreage and yield data for 6 years were compiled by counties in 10 states in the corn belt. The tillage systems were: conventional tillage, all residue removed; conservation tillage, with either 1,500 or 3,500 lb of residue remaining; and no till, with 1,500 or 3,500 lb of residue remaining. Calculated soil losses for each residue and tillage management system combination with assigned crop rotations were compared with the soil loss tolerances defined as the maximum soil loss that is considered safe for continued long-term, maximum productivity of the soil. As the residue and tillage systems become more conservative the soil-loss values decrease, but even with the most conservative, situations arose where the soil loss exceeded acceptable levels. Areas are identified where crop residues may be used for alternate uses, and where they should not be, under any particular tillage regime. When residues are removed the nutrients they would return to the soil must be replaced. (Brambley-SRC)
W82-01770

SEDIMENT ANALYSES FOR SELECTED SITES IN THE SOUTH PLATTE RIVER IN COLORADO AND NEBRASKA, AND THE NORTH PLATTE AND PLATTE RIVERS IN NEBRASKA--SUSPENDED SEDIMENT, BED-LOAD, AND BED MATERIAL,
Geological Survey, Denver, CO. Water Resources Div.
J. E. Kircher.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $6.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-207, 1981. 48 p, 27 Fig, 8 Tab, 4 Ref.

Descriptors: *Data collections, *Suspended sediment, *Bed load, *Watershed management, Sampling, Sites, *Sediment transport, Discharge measurement, Particle size, *Colorado, *Nebraska, South Platte River, North Platte River, Platte River.

Sediment samples were collected on the South Platte, North Platte, and Platte Rivers in Colorado and Nebraska during the 1979 and 1980 runoff seasons. Suspended-sediment concentrations ranged from 62 to 3,705 milligrams per liter and the maximum load was 45,547 metric tons per day. The percentage of suspended sediment samller than sand (less than 0.062 millimeter) was as follows: 23 to 78 percent for the South Platte River, 9 to 30 percent for the North Platte River, and 2 to 89 percent for the Platte River. Bedload-transport rates ranged from 0.0085 to 0.67 kilogram per second per meter of channel width for the entire study area. The median grain size of bedload ranged from 0.6 to 2.6 millimeters for the South Platte River, 0.5 to 0.8 millimeter for the North Platte River, and 0.6 to 1.2 millimeters for th Platte River. The median grain size of bed material for the South Platte River ranged from 0.3 to 2.4 millimeters, compared to 0.5 to 0.9 millimeter for the North Platte River, and 0.4 to 3.1 millimeters for the Platte River. (USGS)
W82-01776

SEDIMENT DATA FOR STREAMS NEAR MOUNT ST. HELENS, WASHINGTON--VOLUME 1, 1980 WATER-YEAR DATA,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01792

DIFFUSION OF SEDIMENT ON THE LEE OF DUNE-LIKE BEDFORMS: THEORETICAL AND NUMERICAL ANALYSIS,
Louisiana State Univ., Baton Rouge. Dept. of Geology.
C. Chakrabarti, and D. R. Lowe.
Sedimentology, Vol 28, No 4, p 531-545, August, 1981. 10 Fig, 1 Tab, 28 Ref.

Descriptors: *Sediment deposition, *Bed load, *Dunes, Sediment transport, Model studies, Numerical analysis, Sediment sorting, Particle size, Deposition.

The diffusion and deposition on the leeside of dune-like bedforms is describing semiquantitatively by theoretical and empirical analysis of flow structure, sediment transport, and sediment size characteristics of the dune crest. Simulation analysis shows that flow velocity, flow depth, and sediment size strongly influence deposition rate and texture of leeside sediment before avalanching. Sorting of this bed material strongly controls grain size and deposition rate gradients. This model can promote understanding of mechanisms of sediment transport and of palaeoflow properties determined from sediment texture analysis. (Cassar-FRC)
W82-01842

ESTIMATING EROSION AND SEDIMENT YIELD ON FIELD-SIZED AREAS,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Engineering.
G. R. Foster, L. J. Lane, J. D. Nowlin, J. M. Laflen, and R. A. Young.
Transactions of the ASAE, Vol 24, No 5, p 1253-1262, 1981. 4 Fig, 4 Tab, 32 Ref.

Descriptors: *Erosion, *Model studies, Sedimentation, Mathematical models, Soil management, Management practices, Erosion control, *Sediment yield.

A model is described which, while simply constructed and usable over a broad range of situations at reasonable cost, embodies the latest knowledge on the fundamentals of erosion mechanics. The model may be used without calibration or collection of data to determine parameter values. It can be linked to hydrologic and chemical transport models and was developed for that specific purpose as a component of CREAMS, a field scale model for Chemicals, Runoff, and Erosion from Agricultural Management Systems. The basis of this model is the assumption that the Universal Soil Loss Equation (USLE) storm erosivity and the peak runoff rate at the watershed outlet can be used to characterize a storm's rainfall, runoff, and sediment yield. A quasi-steady state is assumed. Hydrologically and hydraulically a typical watershed may be divided into areas or elements of overland flow, channel flow, or impounded runoff. Each type of flow is treated in the model with a specific set of equations for that type of flow from an overland flow or channel segment, the model computes a potential sediment load which is the sum of the sediment load from the immediate upslope segment plus that added by lateral inflow within the segment. The model gave reasonable results when compared with data from concave plots under simulated rainfall, single terrace watersheds, small watersheds with impoundment terraces, and a small watershed under conservation tillage. This model may be a useful tool for analyzing the influence of alternate management practices on erosion and sediment yield from field-sized areas. (Baker-FRC)
W82-01849

RESOURCE INVENTORY--SHEET, RILL AND WIND EROSION,
Soil Conservation Service, Washington, DC.
R. I. Dideriksen.
Transactions of the ASAE, Vol 24, No 5, p 1246-1252, September-October, 1981. 4 Fig, 11 Tab, 14 Ref.

Descriptors: *Erosion, *Statistics, Wind erosion, Sheet erosion, Gully erosion, Channels, Rill erosion.

The most up-to-date statistical data available on natural resources was supplied in 1977 by the National Resource Inventories findings. Sheet, rill, and wind erosion continue to be a major national problem. Cropland loss of soil by sheet and rill erosion is estimated to be 1.7 billion tons annually. In 19 states the average cropland erosion rate exceeded 11.2 tons/ha. Fifty percent of all sheet and rill erosion occurs on cropland. Cropland without adequate conservation treatment has an average annual soil loss of 1.5 billion tons, more than eight times the amount on adequately protected land. Pastureland, rangeland, and forest land account for another 1.7 billion tons of soil lost by sheet and rill erosion. The annual erosion rate on pastureland in four states exceeded 11.2 tons/ha. Very steep areas make up one fourth of the total pastureland, but account for 62% of the pastureland erosion. The rangeland sheet and rill erosion rate in four states is more than 11.2 tons/ha. Areas with limiting soil conditions make up one third of the total rangeland acreage, but account for two thirds of the rangeland erosion. About 17% of the nonfederal forest land is grazed and erodes at six times the rate of ungrazed forest land. Wind erosion in the 1976-77 winter blowing season damaged 3.2 million ha of land in the Greater Plain States. The average annual loss due to wind erosion exceeded 11.2 tons/ha on cropland in 3 states and rangeland in 4 states. (Baker-FRC)
W82-01850

THE APPLICATION OF RADIOACTIVE TRACERS FOR DETERMINATION OF BED-LOAD TRANSPORT IN ALLUVIAL RIVERS,
Copenhagen Univ. (Denmark). Dept. of Geography.
T. Thomsen.
Nordic Hydrology, Vol 11, No 3/4, p 133-144, 1980. 4 Fig, 4 Tab, 17 Ref.

Descriptors: *Bed load, *Radioactive tracers, *Alluvial rivers, *Sediment transport, Rivers, Ansager

River, Denmark, Centroid velocity, Mixing, Ripple marks, Tracers.

Bed load transport rate in an alluvial river was determined by a radioactive isotope tracer method. There was a difference of 25% between the results obtained from tracer studies and the values computed by the Engelund and Fredsoe (1976) model on sediment transport. Natural sand (704 g) from the Ansager River, labeled with Cr-51 (activity level 515 mCi) was injected into the river and radioactivity surveyed on 4 occasions. The centroid velocities (in meters per day) were 3.1, 4.9, 1.3, and 1.5 at 6 days, 13 days, 41 days, and 71 days after injection. The higher rates on days 6 and 13 show a higher transport rate of sediment particles in the surface of the mobile layer prior to complete mixing between active and inactive sediment particles. The mixing depth or mobile layer was about 15 cm deep. Activity in the uppermost 4.5 cm was more than twice as high as in the underlying 10 cm. This indicated a maximum ripple form height of 4.5 cm. The material transporting width was about 5.4 cm, range 3.05-9.90. Bed load transport rates were 3.19 tons per day for the 13-41 day period and 3.65 tons per day for the 42-71 day period. (Cassar-FRC)
W82-01893

HYDRAULIC GEOMETRY AND MINIMUM RATE OF ENERGY DISSIPATION,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. T. Yang, C. C. S. Song, and M. J. Woldenberg.
Water Resources Research, Vol 17, No 4, p 1014-1018, August, 1981. 2 Fig, 2 Tab, 30 Ref.

Descriptors: *Energy dissipation, *Channel morphology, *Hydraulic geometry, Rivers, *Sediment transport, Morphology, Equilibrium, Erosion.

The theory of minimum rate of energy dissipation was applied in conjunction with the Manning-Strickler equation and the dimensionless unit stream power equation for sediment transport (Yang, 1973) to a theoretical river with self-formed channels of approximately rectangular shape. The theory states that a system is in equilibrium when its rate of energy dissipation is at a minimum. When a system, such as a river, is subjected to constraints, it adjusts itself until it approaches the equilibrium conditions. The calculated exponents (width, 9/22; depth, 9/22; and slope, -1/6) of the hydraulic geometry relationships proposed by Leopold and Maddock (1953) agreed very well with those measured in the laboratory by Barr et al. (1980). The theoretically derived hydraulic geometry exponents also agreed with observed values from natural river gaging stations. Channel depth can be readily adjusted in accordance with the minimum rate of energy dissipation theory, but width adjustment may depend not only on discharge and sediment load, but also on past history of the river, erodibility of the bank, valley width, vegetation, and man-made structures and improvements. (Cassar-FRC)
W82-01918

SOUTHERN LAKE MICHIGAN SEDIMENTS: CHANGES IN ACCUMULATION RATE, MINERALOGY, AND ORGANIC CONTENT,
Michigan Univ., Ann Arbor. Dept. of Atmospheric and Oceanic Science.
D. K. Rea, R. A. Bourbonniere, and P. A. Meyers.
Journal of Great Lakes Research, Vol 6, No 4, p 321-330, 1980. 4 Fig, 1 Tab, 28 Ref.

Descriptors: *Lake sediments, *Sedimentation rates, Chemical reactions, *Lake Michigan, Sediment deposition, Water-sediment interfaces, Organic matter, Carbonates, Organic carbon, Fulvic acid, Cores, Particle size.

The last 3550 years of sedimentation in southeast Lake Michigan were reconstructed, using data obtained from three 1-meter gravity cores. At a depth of 50-60 cm (3300 years ago) an abrupt decrease in sedimentation rate and changes in sediment character are evident. These are associated with the lowering of water levels shortly after the end of the Nipissing high lake levels 4000 years ago. Sediment accumulation rates are about 50 g per sq m per year through the upper core section and 900 g per sq m per year in the lower section. Median grain sizes are 6.4 phi units at the core surface, 7.3 phi units at 45 cm, and 7-8 phi units for the lower section. In the lower core section (rapid accumulation rate) sediments are finer and contain a higher proportion of carbonates, inorganic C, and humin, and a lower proportion of organic carbon and fulvic acid. The differences in carbonates and organic fractions depend on the residence time in the oxidized surface layer. Rapidly accumulating material has tens of years for carbonate dissolution and organic C decomposition, whereas slowly sedimenting material may be exposed to chemical attack for hundreds of years. (Cassar-FRC)
W82-01958

R-FACTORS FOR SOIL LOSS IMPACT PREDICTION,
Construction Engineering Research Lab., Champaign, IL.
R. E. Riggins, and J. T. Bandy.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 851-857, August, 1981. 3 Fig, 8 Ref.

Descriptors: *Soil erosion, *Rainfall impact, *Prediction, Mathematical equations, *Cropland, Risks, Precipitation.

Soil loss is an important consideration in many environmental impact analysis situations. The universal soil loss equation, described in Agriculture Handbook No. 537 (HB537), can be used to predict soil loss from agricultural lands. However, while agricultural soil loss has generally been predicted on an average annual basis, there is a growing need for consideration of other time intervals. Incorporation of risk into impact analysis also permits the design of erosion control relative to the costs associated with failure. In addition, effective impact analysis requires a source of readily-available, inexpensive data. A procedure has been developed for determining design rainfall erosion indices for given storm periods for use in soil-loss impact analysis. The procedure brings together a new, simpler method of calculating rainfall erosion values, the concept of risk, and readily available precipitation data. Design rainfall erosion values can be selected on the basis of return interval or simple risk. Any time interval up to 1 year can be considered. Application of the technique to precipitation data from stations in Texas and Georgia showed that rainfall erosion values followed a log-normal probability distribution and could be adjusted to be comparable with values published in the HB 537. (Carroll-FRC)
W82-01963

ACCURACY OF SUSPENDED SEDIMENT MEASUREMENTS IN NATURAL STREAMFLOWS,
Institute of Civil and Construction Engineering, Split (Yugoslavia). Faculty of Civil Engineering.
O. Bonacci.
Journal of Hydraulic Research, Vol 19, No 3, p 195-209, 1981. 3 Fig, 6 Tab, 4 Ref.

Descriptors: *Suspended sediments, *Streamflow, *Mathematical models, Analysis of variance, Mathematical studies, Experimental design, Rivers, Drava River, Monte Carolo method, Case studies, Yugoslavia, *Sediment transport.

A simulation model was developed to investigate the influence of individual factors on the pulsation of the suspended sediment transport in the cross-section of an open streamflow. These results, combined with analysis of variance and experimental planning, made it clear that the selection and number of measurement verticals were important and that measurements should be carried out quickly. Satisfactory accuracy can be obtained when 4 to 7 measurement verticals are used. As the concentration of sediment increases, the number of verticals should increase. The position of the sample points on the vertical did not affect the accuracy of suspended sediment measurements. These conclusions were validated by measurements carried out on the profile of the Drava River near Botovo, Yugoslavia. The relative measurement error ranged from 10 to 60%. (Small-FRC)
W82-02002

2K. Chemical Processes

KINETICS FOR THE AQUATIC ENVIRONMENT,
Oregon Graduate Center, Beaverton.
J. F. Pankow, and J. J. Morgan.
Environmental Science and Technology, Vol 15, No 10, p 1155-1164, October, 1981. 7 Fig, 35 Ref.

Descriptors: *Chemical reactions, *Kinetics, *Mathematical studies, *Model studies, *Aquatic environment, Chemical properties, Phosphates, Metal complexes, Differential equations, Mathematical equations, Metals, Iron, Equilibrium, Adsorption, Oxidation, Hydrogen ion concentration.

Many natural water systems never reach complete equilibrium and are governed by the chemical kinetics of the system. In this, the first part of a two-part article, the kinetics of tripolyphosphate hydrolysis and Fe(II) oxidation are discussed. For tripolyphosphate, the most effective condensed phosphate detergent builder, hydrolysis occurs in two steps and obeys a first-order rate law. Equations were formulated to describe changes in orthophosphate concentration as a function of time. Conversion of half of the tripolyphosphate to orthophosphate took about 10 days. If rate constants are increased by a factor of 10, the conversion time is reduced to two days. When anoxic groundwaters surface, when hypolimnetic waters undergo spring and fall overturns, and when acid mine drainage is discharged to a river, the oxidation by oxygen of Fe(II) to Fe(III) takes place. The effects of pH, concentration, and various ligands on the oxidation kinetics are discussed. These findings plus future research on the catalytic oxidation of Mn(II) in the presence and absence of ligand and the adsorption of a metal ion onto the surfaces of suspended particles in the presence of ligand will be used to draw certain conclusions about the appropriateness of kinetics or equilibrium modeling as applied to natural water chemistry phenomena. (Geiger-FRC)
W82-01631

COPPER(II)- AND CADMIUM(II)-BINDING ABILITIES OF SOME NEW HAMPSHIRE FRESHWATERS DETERMINED BY DIALYSIS TITRATION,
New Hampshire Univ., Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 5F.
W82-01632

THE USE OF SPECIFIC CONDUCTANCE IN STUDIES OF NATURAL WATERS AND SOIL SOLUTIONS,
Lanchester Polytechnic, Conventry (England). Dept. of Geography.
For primary bibliographic entry see Field 7A.
W82-01646

WATERSHED CONSTITUENT LOADING ANALYSIS UTILIZING EMPIRICAL HYDRO-CHEMICAL MODELING TECHNIQUES,
Utah State Univ., Logan.
For primary bibliographic entry see Field 5B.
W82-01676

NON-EQUILIBRIUM WATER/ROCK INTERACTIONS,
Stanford Univ., CA. Dept. of Geology.
For primary bibliographic entry see Field 1A.
W82-01684

THE RELATIONSHIP BETWEEN MACRO-TOPOGRAPHY AND THE GROUNDWATER QUALITY IN THE GREAT FISH RIVER BASIN, EASTERN CAPE PROVINCE,

Orange Free State Univ., Bloemfontein (South Africa). Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01718

GROUNDWATER DISCHARGE THROUGH SPRINGS WITH WELL-DEFINED OUTLETS--A CASE STUDY FROM JELOYA-MOSS, S. NORWAY,
Norges Landbrukshoegskole, Vollebekk. Dept. of Geology.
For primary bibliographic entry see Field 2F.
W82-01748

WATER QUALITY STUDY -- SOUTHWEST MINNESOTA PUBLIC WATER SUPPLIES,
Minnesota Univ., Minneapolis. School of Public Health.
C. P. Straub, V. M. Goppers, and R. D. Singer.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-147497, Price codes: A03 in paper copy, A01 in microfiche. Water Resources Research Center, University of Minnesota, Report, March, 1981. 24 p, 7 Fig, 2 Tab, 7 Ref. OWRT-A-038-MINN(1).

Descriptors: *Water quality, *Water resources, *Water supply, *Groundwater, *Surface water, *Public health, *Municipal water, Rock River watershed, Wells, Sampling locations, Glacial aquifers, Bedrock aquifers, Geohydrology, Precipitation, Southwest Minnesota, Minnesota.

Municipal water supplies in the Rock River watershed in Southeastern Minnesota were tested on a monthly basis for two years for the anions nitrate-nitrogen, sulfate, chloride, and bicarbonate alkalinity as CaCO3; and for total dissolved solids, conductivity, and pH. Ratios of the various anions were used to identify changes in water quality not associated with dilution. Seasonal changes in water qualtiy were not necessarily reflcted in changes of ratios; concentrations of nitrate-nitrogen increased in many cases, exceeding permissible concentrations specified in the Interim Primary Drinking Water Standards. High dissolved solids concentrations generally exceeded levels specified in the Secondary Drinking Water Standards. Groundwater concentrations were compared with surface water samples from the several streams, springs, and lakes in the area, and some correlations were made between land use and groundwater quality and precipitation. Data from the study were used to call attention to deficiencies in water quality to water consumers in the communities concerned. (Mullen-IPA)
W82-01795

KINETICS FOR THE AQUATIC ENVIRONMENT,
Oregon Graduate Center, Beaverton.
J. R. Pankow, and J. J. Morgan.
Environmental Science and Technology, Vol 15, No 11, p 1306-1313, November, 1981. 8 Fig, 6 Ref.

Descriptors: *Aquatic environment, *Kinetics, *Equilibrium, *Chemical reactions, Oxidation, Model studies, Chelation, Adsorption, Metals, Manganese, Iron.

A previous paper on kinetic concerned overall reaction rates and the degree to which a pair of opposing reactions within an overall system is maintained at equilibrium. This paper extends the discussion of kinetics in natural water systems to three examples: the autocatalytic oxidation of Mn(2+) in both presence and absence of ligand, and the adsorption of a metal ion on the surface of suspended particulates in the presence of a ligand. The suitabilities of equilibrium and kinetic calculations for inclusion in models are compared for several situations. Equilibrium models are useful when reactions occur very quickly or extremely slowly with respect to the period of interest, for example the conversion of Fe(2+) to Fe(3+) during a rapid autumnal lake turnover. In the absence of equilibrium, kinetics can be used. This requires inclusion of appropriate input or sink terms in the differential equations as well as running mass balance equations. Cases of this type could include algae blooms, sediment remineralization, and antropogenic inputs, although the equilibrium approach may be applicable under certain conditions. (Cassar-FRC)
W82-01806

THE SIGNIFICANCE OF WET AND DRY SYNOPTIC REGIONS ON LONG-RANGE TRANSPORT OF POLLUTION AND ITS DEPOSITION,
British Meteorological Office, Bracknell (England).
For primary bibliographic entry see Field 5B.
W82-01877

THE GEOCHEMICAL CONTROL OF SEAWATER (SILLEN REVISITED),
Massachusetts Inst. of Tech., Cambridge.
R. E. McDuff, and F. M. M. Morel.
Environmental Science and Technology, Vol 14, No 10, p 1182-1186, October, 1980. 3 Fig, 3 Tab, 24 Ref.

Descriptors: *Geochemistry, Alkalinity, *Seawater, Ions, Chemical precipitation, Chemical properties, *Chemical reactions, Geophysics.

The dominant sources and sinks in the oceanic balance of seawater ions are discussed in this consideration of Sillen's classic work on ocean chemistry. The Sillenian concept of a heterogeneous chemical control of seawater alkalinity is reconciled with modern ideas of the processes actually controlling the major ion concentrations in the ocean. An alkalinity loss by calcium carbonate precipitation can balance the alkalinity input from rivers. Alkalinity is also controlled indirectly by carbonate metamorphism, which buffers the CO2 content of the atmosphere. The ocean composition seems to be dominated by geophysical rather than geochemical processes. The acid-base chemistry is fundamentally controlled by heterogeneous chemical processes. (Small-FRC)
W82-01936

GROUNDWATER CHEMISTRY OF SOME SELECTED AREAS IN SOUTHEASTER NORWAY,
Norges Landbrukshoegskole, Vollebekk.
J-O. Englund, and J. A. Myhrstad.
Nordic Hydrology, Vol 11, No 1, p 33-54, 1980. 12 Fig, 2 Tab, 26 Ref.

Descriptors: *Water quality, *Rocks, *Chemical properties, *Groundwater, Aquifers, Groundwater movement, Seawater, Minerals, Brackish water, *Geochemistry, *Norway.

Groundwater in 3 areas of southeast Norway, the Lake Mjosa district, As, and Moss-Jeloy, were characterized by chemical analysis of 98 wells drilled 15 to 110 meters deep in bedrock. Since the groundwater surface in bedrock is usually present well below the overlying morainic or glacifluvial material, the water must penetrate this material. Therefore, weathering of minerals in the unsaturated zone is an important factor in determining the chemical composition of groundwater. The movement of groundwater is so slow that water quality is dependent on the solution of reservoir rocks below the groundwater surface. The highest specific electrical conductances, 550 microS per cm, were in dark calcareous shales, and the lowest, 300 microS per cm, in sandstone and gneisses. In the As and Moss-Jeloy regions, which are below the Late-postglacial marine limit, groundwater is influenced by ancient sea salts and fossil sea water. Groundwater from Late Precambrian rocks contains mainly calcium, bicarbonate, and sulfate; from Cambro-Ordovician rocks, magnesium, sodium, potassium, and bicarbonate. Above the Late-Postglacial marine limit groundwater in gneisses and gabbroes is dominated by calcium and bicarbonate; below this limit, by sodium, chloride, and bicarbonate. The composition of groundwater is largely governed by mineral-water equilibria. Most water samples in this study have not yet reached equilibrium with their surrounding minerals. (Cassar-FRC)
W82-02020

PHYTOBENTHOS OF THE RIVER TEES AND ITS TRIBUTARIES,
Durham Univ. (England). Dept. of Botany.
N. T. H. Holmes, and B. A. Whitton.
Freshwater Biology, Vol 11, No 2, p 139-168, April, 1981. 5 Fig, 4 Tab, 57 Ref.

Descriptors: Measurement techniques, *Benthos, *Phytoplankton, Rivers, Plant populations, Population density, Population dynamics, Algae, Seasonal variation, *Tees River, *Great Britain.

No previous studies of plant communities in flowing water have combined detailed floristic and objective quantitative surveys for a whole stretch of river over an extended period of time, although several meet three of these four requirements. This paper presents a standard method for describing plant communities in fast-flowing streams and rivers which is based on the selection of a representative 10-meter length of the stream which can be relocated exactly. A semi-quantitative account is then developed based on a combination of estimates of the relative areas covered by different physiognomic forms and the relative proportions of species present. Application of this method to the River Tees system in Great Britain is reported. Comparison of semi-quantitative analyses developed for six sites on the river showed that the site located directly below the Cow Green retention reservoir, which site had markedly regulated flows, differed from the other five sites in various ways. Bryophytes were found to comprise a greater cover at this site than elsewhere on the river system throughout the year, and a conspicuous growth of Phormidium occurred in autumn. During late summer and early autumn, filamentous green algae of a variety of species were also abundant at this site. Similar seasonal growth was also found at the site located furthest downstream, where the species Cladophora glomerata was dominant. The two upstream sites experienced conspicuous spring diatom 'bursts', which also occurred about a month later at the two downstream sites. Data from this study indicate that if time permits only one sample to be taken from a particular stretch of river, a sample taken in late summer probably provides the most information on flora and life forms. Appendices provide detailed lists of the taxa and diatoms identified at each of the six sites. (Carroll-FRC)
W82-02065

2L. Estuaries

SALT DISPERSION IN THE HUDSON ESTUARY,
Lamont-Doherty Geological Observatory, Palisades, NY.
K. Hunkins.
Journal of Physical Oceanography, Vol 11, No 5, p 729-738, May, 1981. 4 Fig, 4 Tab, 21 Ref.

Descriptors: *Salinity currents, *Estuaries, *Water currents, *Tidal effects, Salt balance, Shear, Seasonal variation, Mixing, Salinity, Mathematical studies, Tidal currents, *Hudson River estuary, New York.

Salt transport through river estuaries to the sea is balanced by landward dispersion influenced by physical mixing processes. The currents and salinity levels of the lower Hudson estuary were studied to evaluate the relative importance of these dispersion processes. Weakly significant correlations existed between wind and currents. Three cross-sectional surveys provided estimates of salt dispersion by other practices. Current and salinity data were decomposed into various temporal and spatial means, and departures from these means and covariances between the various quantities were interpreted in terms of physical dispersion processes. The steady shear of gravitational circulation was the main cause of salt dispersion in the lower Hudson estuary. Between spring high-flow and summer low-flow conditions, steady shear salt dispersion varied by a factor of 5. Salt dispersion by tidally varying shear was lower in magnitude. The relations between sectionally averaged current and salinity yielded a negative dispersion, which was attributed to the tendency of bottom tidal

currents to lead upper layer currents in phase and the increased longitudinal salinity gradient near the surface. (Geiger-FRC)
W82-01615

NITRATE REDUCTION TO AMMONIUM AND ORGANIC NITROGEN IN AN ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 5B.
W82-01625

COHERENCE BETWEEN WIND AND CURRENT EVENTS IN A NEARSHORE, SHALLOW WATER, WAVE DOMINATED ENVIRONMENT,
Old Dominion Univ. Norfolk, VA.
G. M. Hecker.
PhD Dissertation, 1980. 123 p, 41 Fig, 36 Ref, 3 Append, University Microfilms International, Ann Arbor, MI; Order No GAX81-11390.

Descriptors: Winds, *Current meters, *North Carolina, Currents, Waves, Tidal waters, Shallow water, *Wave action, Nearshore, *Wind-driven currents.

Five days of observation were made of the current at four depths in a water depth of eight meters, and accompanying record of local wind one-half kilometer from shore at the U.S. Army Corps of Engineers Coastal Engineering Research Center field facility at Duck, North Carolina beginning five May 1978. The current was measured with a state-of-the-art electromagnetic current meter having a 0.2-second response time and an accuracy of + or - 2 centimeters per second. At each depth a ten-minute record was made each hour with a sampling interval of one-eighth second. The frequency components of the record were analyzed and found to be essentially free from noise and bias. The record of one hundred and twenty (less five lost due to loss of amplifier power supply) ten-minute averages was also analyzed for frequency components. Semidiurnal and diurnal tidal components and quadratic curve trends were identified. Analyses by fast fourier transform revealed that the component of the wind perpendicular to the coast had significant coherence with the alongshore component of the current. (Sinha-OEIS)
W82-01674

NUMERICAL ANALYSIS OF TRANSIENT SALT/FRESH-WATER INTERFACE IN COASTAL AQUIFERS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W82-01693

HYDROLOGY OF OKARITO LAGOON AND THE INFERRED EFFECTS OF SELECTIVE LOGGING IN OKARITO FOREST,
Forest Research Inst., Christchurch (New Zealand).
For primary bibliographic entry see Field 4C.
W82-01703

FIELD OBSERVATIONS OF THE ISOTOPIC COMPOSITION OF PARTICULATE ORGANIC CARBON IN THE SOUTHERN NORTH SEA AND ADJACENT ESTUARIES,
Institute for Soil Fertility, Groningen (Netherlands). Delft Hydraulic Lab.
For primary bibliographic entry see Field 2J.
W82-01714

DISTRIBUTION, MORPHOLOGY, AND ORIGIN OF SEDIMENTARY FURROWS IN COHESIVE SEDIMENTS, SOUTHAMPTON WATER,
Institute of Oceanographic Sciences, Taunton (United Kingdom).
R. D. Flood.
Sedimentology, Vol 28, No 4, p 511-529, August, 1981. 18 Fig, 44 Ref.

Descriptors: *Estuaries, *Bottom sediments, *Water currents, Furrows, Cohesion, Erosion, Deposition, Sedimentology, Southampton Water, Drowning, *Sediments, Sediment distribution.

Furrow morphology, sediments, structure and associated water flow were observed during a year-long investigation of Southampton Water furrows. Studies included side-scan sonar/fathometer surveys, diver observation and sampling, temperature/salinity measurement, and current speed measurement. Furrows in six well-defined patches apparently resulted from short periods of erosion followed by long periods of deposition. All of the furrows are parallel, 0.5 to 15 m troughs aligned with the dominant current. Some furrows have different characteristics such as width. Narrow furrows accumulate sediment at greater than 3.6 cm/year. Coarse sediments such as shells fill the bottoms of furrows and act to widen the furrows when moved by currents. Large furrows may remain in the same place for 12 years, while small furrows may last a month. (Small-FRC)
W82-01720

GEOCHEMISTRY AND HYDRODYNAMICS IN THE HUTT AND LEEMAN EVAPORITIC LAGOONS, WESTERN AUSTRALIA: A COMPARATIVE STUDY,
Uranerz Australia Party, Ltd., Subiaco.
A. V. Arakel.
Marine Geology, Vol 41, No 1-2, p 1-35, May, 1981. 14 Fig, 4 Tab, 25 Ref.

Descriptors: *Hydrologic cycle, *Playas, Lake basins, Seawater, Ponds, Ponding, *Geochemistry, *Lagoons, Precipitation, Lake beds, Groundwater, Lake sediments, Lake evaporation, Minerals, Sedimentation, Brines, *Australia, Hydrodynamics.

The geochemical characteristics and hydrologic circulation of the Hutt and Leeman Lagoons, located in the northern part of the Perth Basin, Western Australia, are compared. These lagoons are shallow evaporative basins which resulted from ponding in a Pleistocene dune terrain. The present-day lagoons have playa surfaces in which sedimentation is related to the distribution and interaction of groundwaters, seawater, and lagoonal brines. Precipitation is limited to ephemeral halite in ponded waters along with the diagenetic emplacement of calcium carbonate and calcium sulfate in sediments. The lagoonal circulation is controlled predominantly by playa surfaces, which are mostly below sea level. A net influx of sea water, impelled by a hydrostatic head of up to 4 meters, is balanced each season by evaporative reflux. (Geiger-FRC)
W82-01746

SEASONAL AND SPRING-NEAP TIDAL DEPENDENCE OF AXIAL DISPERSION COEFFICIENTS IN THE SEVERN - A WIDE, VERTICALLY MIXED ESTUARY,
Institute for Marine Environmental Research, Plymouth (England).
R. J. Uncles, and P. J. Radford.
Journal of Fluid Mechanics, Vol 98, No 4, p 703-726, June, 1980. 7 Fig, 3 Tab, 25 Ref.

Descriptors: *Estuaries, *Diffusion coefficient, *Salinity, *Tidal effects, Seasonal variation, Runoff, Saline-freshwater interfaces, *Severn estuary, *United Kingdom.

Results are presented for the seasonal and spring-neap tidal dependence of the dispersion coefficient in the Severn Estuary based on observations of the axial salinity distributions during 1971-1976. Results are also given for the seasonal dependence of residence times expressed as functions of axial distance along the estuary. The coefficients were derived from salt budget calculations based on 29 sets of observations, and regression analysis was used to determine simple linear and logarithmic relationships for the dispersion coefficients in terms of tidal range and the total rate of input of fresh water. Generally, the coefficients increased with increasing runoff and usually depended upon tidal range. There was a small decrease with increasing tidal range in the seaward part of the estuary and a large increase with increasing tidal range towards the head. Yearly averaged coefficients ranged from 1000 to 10,000 sq m/sec. When dispersion coefficients were applied to calculations of residence times, the residence time of the whole estuary varied from about 100 days during the winter to 200 days during the summer. (Small-FRC)
W82-01749

ESTUARINE DREDGE AND FILL ACTIVITIES: A REVIEW OF IMPACTS,
Florida State Dept. of Environmental Regulation, Tallahassee,
S. A. Johnston, Jr.
Environmental Management, Vol 5, No 5, p 427-440, September, 1981. 6 Fig, 33 Ref.

Descriptors: *Dredging, *Estuaries, *Silting, Suspended load, Turbidity, *Ecological effects, Suspended solids, Environmental effects, Fish, Aquatic life.

The effects and impacts of dredge and fill activities on estuaries are discussed with emphasis on biological and water quality impacts. Recommendations are made for improving and mitigating deleterious effects. The biological effects of turbidity may cause reduced visibility and reductions in the availability of food for fish. High levels of suspended solids can reduce oyster growth and may have toxic effects on various larvae. Dissolved oxygen concentrations are lower near some dredging and filling sites, and pH can be reduced. Siltation can have drastic effects, including the immediate removal of organisms through suffocation and the long-term elimination of many desirable species of flora and fauna. Resuspension of bottom materials can result in the release of nutrients as well as the possible release of toxicants. Where coastal wetlands can not be circumvented during construction projects, bridging should be used rather than filling and embankment. The turbidity caused by dredging and filling can be reduced through the use of a turbidity diaper. (Small-FRC)
W82-01805

A SENSITIVITY ANALYSIS OF AN ECOSYSTEM MODEL OF ESTUARINE CARBON FLOW,
South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology.
J. K. Summers, and H. N. McKellar, Jr.
Ecological Modelling, Vol 13, No 4, p 283-301, September, 1981. 3 Fig, 5 Tab, 36 Ref.

Descriptors: *Estuaries, *Ecosystems, Dynamics, Organic matter, *Model studies, Sensitivity analysis, North Inlet, Sedimentation, Coastal waters, *Carbon cycle.

An estuarine carbon exchange model is examined using some techniques from systems theory, principally sensitivity analysis. The use of such techniques is demonstrated, and suggestions are made for their application to large ecosystem research projects. The model employed in the analysis has recently been used to estimate the annual net exchange rates of carbon between the North Inlet estuary, South Carolina, and the ocean as well as to elucidate the sources and storages of this carbon flow. The model is a 19-compartment real time deterministic formulation of the four major subsystems which comprise the North Inlet estuary: marsh, water column, oyster reef and subtidal benthos. To estimate parameter performance for the model, sensitivity analysis was performed on the 122 parameters over long periods of 5 years to ensure that long-term effects would be visible. Statistical relationships between perturbations of component interactions and system behaviors were investigated using these analyses. The major conclusion from a study of this model is that much more research is needed in the North Inlet system before a more precise structural framework for the North Inlet model can be attempted. Primary areas for continued research include characterization of the interaction between marsh grasses and algae; the extent of microbial recycling of dissolved organic carbon in the water column; and the community energetics of the North Inlet nekton and avian fauna. Concerning total organic exchange with the sea, specific research is needed into the variability

and controls of particulate organic matter in coastal waters, photosynthesis, planktonic microbial respiration, dissolved organic matter utilization by microbes, tidal washout from the marsh surface, and sedimentation from the water column to the subtidal sediments. (Baker-FRC)
W82-01875

GULF OF MEXICO WETLANDS: VALUE, STATE OF KNOWLEDGE AND RESEARCH NEEDS,
National Marine Fisheries Service, Beaufort, NC. Southeast Fisheries Center.
G. W. Thayer, and J. F. Ustach.
In: Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX), Key Biscayne, Florida, 30 September - 5 October 1979, Volume IIB, May, 1981. p 1-30, 3 Fig, 3 Tab, 73 Ref. National Oceanic and Atmospheric Administration, Miami, Florida.

Descriptors: *Wetlands, *Estuaries, *Habitats, *Ecosystems, *Fisheries, Aquatic habitats, Spatial distribution, Detritus, Spawning, Vegetation, Fauna, Growth, Coastal marshes, *Gulf of Mexico.

Approximately 50% of the commercial and recreational fishes in the Gulf of Mexico and 80-90% of the fishery landings are estuarine-dependent. Coastal wetlands provide habitats and food resources that make estuarine-nearshore zones vital spawning, nursery and feeding areas for aquatic species. Although there is a great deal of information on plant species in Gulf wetlands, little quantitative data exist on mixed species communities and submergent species and on the factors regulating growth and production of most wetland plants. There is a paucity of quantitative data on the abundance and distribution of faunal components, including forage species and meiofauna, and on growth and mortality rates of juvenile fishes, age-specific utilization, and resource partitioning within wetland habitats. One of the most important, yet poorly understood, aspects of wetland ecology is the production, decomposition, utilization, and export of detrital material from Gulf wetlands. When one considers that about 75% of the total plant production in Gulf estuarine-wetland areas is derived from macrophytes, the importance of developing a sound information base on the decomposition process is obvious. Intensive long-term studies on a few systems and extensive short-term studies on many systems on a regional basis within the Gulf are needed to understand natural variability among organisms and their habitats, as well as the range of conditions and variability of wetland ecosystems. (Moore-SRC)
W82-01902

APPARATUS TO PRODUCE TIDAL FLUCTUATIONS IN A SIMULATED SALT MARSH SYSTEM,
University of West Florida, Pensacola.
C. R. Cripe.
Progressive Fish Culturist, Vol 42, No 1, p 32-33, January, 1980. 3 Fig, 3 Ref.

Descriptors: *Salt marshes, *Tides, *Laboratory equipment, Tidal marshes, Water level fluctuations, Estuarine environment, Simulators, *Pesticide kinetics.

An apparatus was designed to aid in studying pesticide dynamics in simulated salt marsh systems by producing tidal fluctuations in tanks. Water entered the test tanks (3 m in diameter and 0.6 m deep) at 3 liters/min through a siphon and headbox arrangement and discharged through a constant-level excurrent siphon that could be raised and lowered by a motor and gear assembly. During each revolution of the motor, the apparatus raised and lowered the water level in the tank about 10 cm, which simulated a sinusoidal tidal cycle. The motor and gear apparatus control timing and can be changed to vary the tidal cycle. (Small-FRC)
W82-01930

PHYTOPLANKTON DISTRIBUTIONS OBSERVED DURING A 3 1/2 DAYS FIXED-STATION IN THE LOWER ST. LAWRENCE ESTUARY,
Quebec Univ., Rimouski. Dept. of Oceanography.
M. Sinclair, J. P. Chanut, and M. El-Sabh.
Hydrobiologia, Vol 75, No 2, p 129-147, October, 1980. 11 Fig, 4 Tab, 35 Ref.

Descriptors: *Phytoplankton, *Species diversity, *Turbulent flow, Estuaries, Chlorophyll, *St. Lawrence estuary, Thalassiosira, Species composition, Niches, Productivity, Variability, Diatoms, Flagellates, Biomass.

Phytoplankton biomass, species composition, and variability in physiological state were investigated from July 31 to August 4, 1975, during a fixed station cruise off Rimouski, Wuebec, in the St. Lawrence Estuary. The temperature-salinity data and current data suggest that a single water mass on the order of tens of kilometers was present during this study. The surface composition of phytoplankton was relatively constant. In areas of high chlorophyll, Thalassiosira were dominant. Pennate diatoms and flagellates dominated at a surface discontinuity in salinity. The biomass distributions appeared to be a function of physical (turbulence, etc.) rather than biological processes in this small-scale study. On the scale of hours and kilometers, the biomass and primary productivity varied widely. The ratios of productivity/biomass and carbon/chlorophyll were associated with species composition differences. Niche diversity (as indicated by the relative constancy in species composition) was low despite the physical heterogeneity of the surface water. This is a result of the high turbulence associated with estuarine environments. (Cassar-FRC)
W82-01938

WATER QUALITY IMPACTS EXCHANGING WATER BETWEEN SEA AND A CLOSED ESTUARY,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
For primary bibliographic entry see Field 5G.
W82-01991

TIDE-INDUCED RESIDUAL FLOW IN SHALLOW BAYS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
J. Van De Kreeke, and A. A. Chiu.
Journal of Hydraulic Research, Vol 19, No 3, p 231-249, 1981. 5 Fig, 23 Ref.

Descriptors: *Flow patterns, *Tidal effects, *Bights, Bays, Shallow water, Eddies, Mathematical studies, Flow velocity, Residual flow.

Residual flow patterns were computed in a square bight and a semi-enclosed basin using a finite difference technique. The computations for the square bight suggested that the differences between the Lagrangian mean velocity and the residual flow divided by the mean depth are small. The tidally averaged equations demonstrated the dynamics of the tide-induced residuals. These equations' source terms were interpreted as residual stresses associated with the first order tidal motion. When restricted to the interior of the square bight, good agreement was found between numerically and semi-analytically computed residual flows. Numerically computed residual flow patterns for the semi-enclosed basin showed large eddies. Eddies are not present in the tidal flow. The present difference formulation of the advective terms may need modification. (Small-FRC)
W82-02003

ON SOME CHYTRIDS FOUND IN ESTUARINE HABITATS,
Institut fuer Meeresforschung, Bremerhaven (Germany, F.R.). Dept. of Botany.
A. Ulken.
Botanica Marina, Vol 23, No 6, p 343-352, June, 1980. 11 Fig, 1 Tab, 13 Ref.

Descriptors: *Fungi, *Aquatic fungi, *Estuaries, Bottom sampling, Brackish water, Water pollution effects, Rivers, Weser River, Federal Republic of Germany, River Tay, Great Britain, Comparison studies.

The occurrence of chytrids and thraustochytrids at seven stations between Bremerhaven and Bremen-Lesum on the river Weser were observed from 1976 to the present. Bottom samples which included small amounts of mud were taken monthly, and fungi from the samples were grown for two to four weeks. Nine species of fungi were isolated, all of which were able to live and propagate in brackish waters. Sporulation mechanisms were observed, and physiological abilities were investigated, including the destruction of keratin and chitin materials. Results from the river Weser fungi were compared with results obtained in an investigation of fungal occurrence in the river Tay in the United Kingdom, between Dundee and Perth. The Tay is unpolluted, while the Weser contains industrial salts from the Kali mines. River Tay results were similar to those of the river Weser. (Small-FRC)
W82-02038

PCB AND HCB IN THE SEDIMENTS AND WATERS OF THE TIBER ESTUARY,
Rome Univ. (Italy). Ist. d'Igiene.
G. Puccetti, and V. Leoni.
Marine Pollution Bulletin, Vol 11, No 1, p 22-25, January, 1980. 1 Fig, 6 Tab, 30 Ref.

Descriptors: *Marine sediments, *Estuaries, *Pollutants, *Tiber River, Italy, *Sediments, Polychlorinated biphenyls, Benzenes, Chlorinated hydrocarbons, Toxicity, Water pollution, Hexachlorobenzene.

Environmental pollution by polychlorinated biphenyls (PCB) has received considerable attention since the substance was discovered in animal tissues in 1966. Various studies have established its presence in aquatic sediments, wastewaters, organisms, and food. Previous research has demonstrated the presence of PCB in the catchment area of the Tiber River in Italy. This study investigated the range of PCB and of hexachlorobenzene (HCB) in the coastal seawaters and sediments of the mouth of the Tiber. Although HCB has limited and controlled applications in agriculture in Italy, the substance is diffused throughout the environment. Water analyses showed that PCB was present in 85 of 86 samples taken over a two year period in concentrations ranging from 0.009 to 1,000 parts per billion (ppb), with a mean value of 0.297 ppb. The four sediment samples all contained PCB, in concentrations ranging from 28 to 770 ppb. Only 16 percent of the water samples contained HCB, with concentrations ranging from 0.002 to 0.01 ppb, and none of the sediment samples contained HCB. These findings with respect to HCB indicate that the substance is not stable in the marine environment or that it is diluted there. Sampling sites closer to the coast contained less PCB than ones further out, suggesting that the water from the Tiber River acts as a microbiological decontaminating agent or that pollution of the marine environment further from the coast occurs through the atmosphere. The PCB concentrations found in this study are 100 to 300 times higher than the concentration considered acceptable on the basis of toxicity experiments with aquatic organisms. It is recommended that Italy develop standards for the concentrations of PCB in urban and industrial effluents. (Carroll-FRC)
W82-02057

ECONOMIC INSTRUMENTS FOR CONTROLLING EFFLUENT DISCHARGES TO THE RIVER TEES ESTUARY,
Newcastle upon Tyne Univ. (England). Dept. of Economics.
B. Beavis, and C. K. Rowley.
Marine Pollution Bulletin, Vol 11, No 5, p 120-124, May, 1980. 1 Fig, 6 Ref.

Descriptors: *Effluents, *Water pollution control, *Economic aspects, Industrial wastewater, *Great Britain, Mathematical models, Estuaries, Feasibility studies, Water quality standards, Taxes, Costs, Cost-benefit analysis, *Tees River.

For many years England and Wales have applied statutory controls of effluent discharges less strictly in the case of tidal rivers and estuaries than in the case of non-tidal rivers. Following a recom-

mendation in 1972 that all industrial discharges to tidal waters and estuaries be brought under statutory control, alternative control mechanisms, and particularly the feasibility of using a system of charges instead of consents for controlling effluent discharges, were investigated. A one-dimensional water quality model of the River Tees, in which parameters vary only with respect to distance along the river, was combined with a cost abatement model to permit estimation of the pattern of abatement which would achieve specific water quality standards within specific time periods at the minimum aggregated private costs to all major dischargers. A multi-period approach permitted evaluation of the costs of introducing a variety of abatement procedures at different specific time periods at two year intervals over a 10-year period. Least cost solutions were found to be sensitive to both the level of water quality achieved and the date by which the water quality standard was required to be achieved. The solutions were generaly insensitive to the choice of discount rate. The study results indicate that a tax-price solution based on some knowledge of spatial water quality considerations and erring on the side of harshness in order to guarantee the satisfaction of the water quality standard on the basis of the initial tax-price vector may provide a less costly alternative than consents. The tax-price solution is shown to be an economically feasible approach in the case of the River Tees. (Carroll-FRC)
W82-02060

AMERICIUM IN INTERTIDAL SEDIMENTS FROM THE COASTAL ENVIRONS OF WINDSCALE,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
For primary bibliographic entry see Field 5B.
W82-02098

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

CYCLING ZONE ADSORPTION APPLIED TO PURIFICATION OF BRACKISH WATER WITH THERMALLY REGENERABLE ION-EXCHANGE RESINS,
Delaware Univ., Newark. Dept. of Chemical Engineering.
K. S. Knaebel.
PhD Dissertation, 1980. 195 p, 46 Fig, 19 Tab, 104 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19939. NSF-ENG 77-19951.

Descriptors: *Desalination, *Ion exchange, *Separation techniques, Water treatment, Brackish water, Mathematical models, Resins, Cycling zone adsorption, Deionization.

Cyclic variation of the temperature of a dilute aqueous NaCl feed to a fixed bed of thermally regenerable ion-exchange resin leads to alternate purification and enrichment of the product. The effects of operating conditions and staging of zones in series on separation are examined experimentally. The resins considered are Amberlite XD-2 and XD-5; the latter exhibits superior exchange capacity. A mathematical model that accounts for dissipative processes is proposed, and agrees with experimental results at high flow rates and cycling frequencies. A second model, which incorporates the Langmuir isotherm but assumes local equilibrium, is developed and agrees with experimental results at low flow rates and low cycling frequencies. An economic feasibility study indicates that the process is competitive with reverse osmosis and other deionization processes. (Sinha-OEIS)
W82-01696

MULTI-SALINE SAMPLE DISTILLATION APPARATUS FOR HYDROGEN ISOTOPE ANALYSES: DESIGN AND ACCURACY,
Geological Survey, Reston, VA. Water Resources Div.
A. A. Hassan.
Available from the National Technical Information Service, Springfield, VA 22161 as PB82-115460, Price codes A02 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 81-25, 1981. 4 p, 1 Fig, 2 Ref.

Descriptors: *Water sampling, *Distillation, *Salinity, Dehydration, Hydrogen, Isotope studies, Temperature, Stable isotopes.

A distillation apparatus for saline water samples was designed and tested. Six samples may be distilled simultaneously. The temperature was maintained at 400 C to ensure complete dehydration of the precipitating salts. Consequently, the error in the measured ratio of stable hydrogen isotopes resulting from incomplete dehydration of hydrated salts during distillation was eliminated. (USGS)
W82-01789

3C. Use Of Water Of Impaired Quality

COMPOSITION OF FRUIT AND VEGETABLE PROCESSING WASTES,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
For primary bibliographic entry see Field 5D.
W82-01601

RIVER BASIN SEQUENTIAL WATER USE AND SALINITY EFFECTS ON CROP YIELD ECONOMICS,
Utah State Univ., Logan.
For primary bibliographic entry see Field 3F.
W82-01671

FOOD AND ENERGY PRODUCTION: CONJUNCTIVE WATER PLANNING,
Wright Water Engineers, Inc., Denver, CO.
W. L. Lorah, and K. R. Wright.
Journal of Hydrology, Vol 51, No 1-4, p 89-96, May, 1981. 1 Fig, 1 Tab, 1 Ref.

Descriptors: *Conjunctive use, *Water reuse, *Semiarid lands, Land reclamation, Irrigable land, Oil fields, Saline soils, Cropland, Leaching, Salts, Suspended solids, Dissolved solids, Injection, Multiobjective planning.

As competition for water between energy and agricultural interests increases, it is ever more necessary to find innovative approaches to water management which optimize limited water resources. A plan is presented which could meet the needs of both a large-scale waterflooding scheme for increased oil production and irrigation for a cropland reclamation project. Oil production and agricultural lands are frequently found in the same area in much of the Persian Gulf region. Modern irrigation techniques can be used to reclaim much of the cropland in this region, which has become saline and less productive, through the process of leaching. The proposed conjunctive water supply and treatment plan calls for river water to be diverted onto the saline lands for treatment to remove suspended solids. At the same time, this treatment process would leach salts from the soil. The treated water and the salts would then be captured by an underground drainage system for delivery to the oil field for subsequent injection around the oil reservoir. Use of the leachate from the agricultural sector as an acceptable raw supply for the oil industry would eliminate the need to construct a costly mechanical water treatment plant. Expenses eliminated by the plan could be used to assist a land development program, which might otherwise be economically impractical. The primary consideration for the oil industry in developing such a conjunctive use plan would be economic water treatment. The agricultural sector would need to evaluate both costs and benefits and would need to experiment with various crops. Factors which could make land treatment infeasible are identified, and field and laboratory work that must be undertaken to determine feasibility is described. (Caroll-FRC)
W82-01856

REARING PACIFIC SALMON IN SALTWATER PONDS FERTILIZED WITH DOMESTIC WASTEWATER, DATA REPORT, JUNE 1979 - MAY 1980,
Humboldt State Univ., Arcata, CA. Dept. of Fisheries.
G. H. Allen, J. Hedgepeth, J. Pandozzi, and M. Jennings.
August, 1980. 73 p, 10 Fig, 28 Tab, 27 Ref, Append.

Descriptors: *Wastewater renovation, *Fish physiology, *Fish populations, *Salmon, Trout, Municipal wastewater, Fish stocking, Fisheries, Wastewater treatment, Oncorhynchus, Fish, *Arcata, California.

Two experiments concerned with raising juvenile salmonids in two 0.15-hectare wastewater-seawater fish ponds were conducted at the City of Arcata, CA, sewage treatment facility on the north arm of Humboldt Bay. Rainbow trout (Salmo gairdneri) were reared in one pond during the summer of 1978, and rainbow trout and coho (silver) salmon (Oncorhynchus kisutch) were reared together in both ponds from fall 1979 to spring 1980. Survival of trout in summer was less than 10 percent for both vibriosis-vaccinated and unvaccinated trout. It is suggested that the probable causes of low survival were periods of high water temperature (24-25 degrees centigrade), especially when combined with salinities of approximately 20 ppt. Survival of coho salmon and trout in winter rearing was high in ponds--at least 60 percent, and perhaps as high as 90 percent in South Pond. Rainbow trout survival was good but lower than for coho. Coho salmon and steelhead rainbow trout reared in four-meter square pens all showed high survival in the 60- to 96-percent range. Trout grew to a larger size than coho over a shorter rearing period and provided a net production of fish from the ponds. Coho growth was mainly in late winter and spring months prior to smolting, with slightly less weight of coho biomass in the ponds at the end of the rearing period than at the beginning. Density-dependent relationships between number of fish per unit area, length attained by surviving fish, and percent of smolting were established, using both pen-reared and pond-reared fish. As currently managed, natural flood production would allow at least 10,000 25-gram smolts to be produced in one of the 0.15-hectare ponds. (Garrison-Omniplan)
W82-01906

A PROPOSAL FOR RECLAMATION BY DILUTION OF IRRIGATION WATER,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, G. Sinai, and L. H. Stolzy.
Irrigation Science, Vol 1, No 3, p 161-168, 1980. 5 Fig, 3 Tab, 12 Ref.

Descriptors: *Soil reclamation, *Irrigation water, *Saline water, *Saline soils, Water quality control, Solute transport, Reclamation, Salts, Agricultural hydrology, Cooling water, Drainage water, Controlled drainage, Leaching, Root zone, Model studies, Reclaimed water.

Reclamation of a soil salinized from irrigation with saline water was explored using a salt transport-chemical equilibrium model. The procedure involves a saline irrigation water derived from power plant cooling water residual (EC = 4.2 mmho per cm) diluted with well water (EC = 0.5 mmho per cm) to produce a mixture (EC = 1.4 mmho per cm) which is alternated with the saline water in 2-year cycles. This method allows continued use of the land and minimizes the discharge of salt below the root zone. During the saline irrigation year some salt is precipitated, and some if redissolved during the diluted irrigation year, for a net precipitation of 18% for the complete cycles. This compares with a net precipitation of zero for traditional methods. Although traditional leaching methods reduce salinity and sodicity of the root zone faster than the dilute irrigation method, they

allow more salt to be carried below the root zone and hence to the groundwater or other receiving waters. (Cassar-FRC)
W82-01943

3E. Conservation In Industry

MANAGING WATER AT HELICOPTER PLANT,
For primary bibliographic entry see Field 5D.
W82-01974

3F. Conservation In Agriculture

FURROW ADVANCE RATES UNDER SURGE FLOW SYSTEMS,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
A. A. Bishop, W. R. Walker, N. L. Allen, and G. J. Poole.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 257-264, September, 1981. 6 Fig, 6 Ref.

Descriptors: *Irrigation efficiency, *Furrow irrigation, *Infiltration rate, *Surges, Water conservation, Compacted soils, Soil compaction.

A study of furrow irrigation proved that the advance phase was accomplished with less water using surge flows than with continuous flows. In a field planted to corn with 30 inch row spacing, 600 ft long furrows, and 1.46% average slope, two types of furrows alternated: wheel furrows (compacted by tractor wheels) and non-wheel furrows (unaffected by tractor wheels). Differences between advance rates in surge flow and continuous flow were very pronounced in the first water application to newly formed non-wheel furrows. The time required for the water to advance to the end of the 600 ft row was less than 500 min for surge flows (10 min cycles--1/3 on and 2/3 off, 1/2 on and 1/2 off, and 2/3 on and 1/3 off) and 3500 min for continuous flow. In non-wheel furrows on the second irrigation, advance times for the 600 ft row were 650 min for continuous flow and 100 to 350 min for the three surge flow regimes. Changing the cycle time to 20 min increased the advance time in surge flow to 80 min, compared with 40 min for a 10 min cycle and 240 min for continuous flow in the same trial. There was no significant difference between 5, 10, and 20 min cycles in newly formed non-wheel furrows. Apparently, surge flow altered the characteristics of the furrow, accelerating the development of thin surface seals in the bottom of the furrows and decreasing permeability. This research indicates that surge flow can reduce the volume of water needed for the advance phase, equalize water distribution, and eliminate runoff. (Cassar-FRC)
W82-01612

CASE STUDIES OF AGRICULTURAL WATER CONSERVATION,
Sonnen (M. B.) Co., Inc., Walnut Creek, CA.
M. B. Sonnen, B. B. Dendy, and K. P. Lindstrom.
Water Resources Bulletin, Vol 17, No 3, p 394-398, June, 1981. 2 Tab, 5 Ref. OWRT-C-90134-C(9428)(2), 14-34-0001-9428.

Descriptors: *Agriculture, *Surveys, *Economic aspects, *Water conservation, Farming, Irrigation practices, Loans, Land leveling, Conjunctive use, Water reuse, Public opinion, Planning.

A survey of 13 farmers in four irrigation districts located in California and Texas revealed that a majority was in favor of changing their water delivery systems to closed conduits, removing phreatophytes, reusing irrigation tail water, and avoiding salinity problems. Farmers responded negatively to proposals for collecting local runoff for irrigation, altering land to capture excess rainfall, locating an additional surface water source, developing soil salinity problems with their current irrigation methods, and installing drains. The most widespread methods of water conservation in use were land leveling, especially with laser controlled equipment; adjusting crops to water short periods; and reuse of irrigation tail waters. Conjunctive use of ground and surface waters is almost universally practiced. Water conservation is practiced because of its economic benefits, not for altruistic or ethical purposes. Farmers would respond to incentives for further water conservation practice. Although greater government incentive mechanisms would not be likely to reduce water use much more than 15%, training and education programs and increased loan programs for installation of water conservation equipment are recommended. (Cassar-FRC)
W82-01667

RIVER BASIN SEQUENTIAL WATER USE AND SALINITY EFFECTS ON CROP YIELD ECONOMICS,
Utah State Univ., Logan.
H. O. Fapohunda.
PhD Dissertation, 1980. 319 p, 32 Fig, 44 Tab, 70 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19243.

Descriptors: Water resources, *Model studies, *River basins, Resources development, *Salinity, Crops, Economics, Agriculture, *Crop yield, Economic aspects, Impaired water use, Water use, Sequential Use Model, *Nigeria, Resources management, Crop yield economics.

An economic simulation model is combined with an existing hydrologic and salinity model (BSAMS) in order to predict management effects of sequential water use in a river basin. The hydrologic, salinity and economic systems are closely interrelated in any water resource project. Comprehensive planning is difficult if the three systems are analyzed independently; hence, it is advantageous to incorporate all three systems into a single working model, now called the Sequential Use Model. This model uses functions which relate seasonal crop evapotranspiration and soil solution salt concentration to yields. In essence, the output from the hydrologic (seasonal evapotranspiration) and salinity (soil solution salt concentration) models become inputs into the economic model, which predicts the net return to the given hydrologic and salinity conditions. The model provides a means of determining the relative efficiency of water use with respect to production or net returns for several management alternatives. The marginal values of water can be evaluated for all alternative uses or cropping schemes and the most profitable can then be selected. The sequential use model is applied to an actual hydrologic unit, the Madejia-River Basin in Nigeria to demonstrate its applicability to management and planning problems. (Sinha-OEIS)
W82-01671

EXPLOITING THE WATERS OF LAKE CHAD.
For primary bibliographic entry see Field 8A.
W82-01726

IMPRESSIONS OF SOIL AND WATER CONSERVATION IN CHINA,
Soil Conservation Service, Washington, DC.
For primary bibliographic entry see Field 4D.
W82-01730

THE CHAMBAL PROJECT: PROBLEMS AND SOLUTIONS,
Madhya Pradesh Irrigation Dept., Bhopal (India).
For primary bibliographic entry see Field 4A.
W82-01739

IRRIGATION FOR BRAZIL'S POLIGONO DAS SECAS,
Themag Engenharia Ltda., Sao Paolo (Brazil).
F. M. G. Budweg.
International Water Power and Dam Construction, Vol 33, No 8, p 20-22, August, 1981. 1 Fig, 3 Ref.

Descriptors: *Irrigation programs, *Civil engineering, Wates resources development, *Semiarid lands, Resources development, Irrigation, Drought, Flood control, Sao Francisco River, *Brazil.

A regional plan to divert wet season runoff of the Sao Francisco river over long distances for irrigation to mitigate the problems of drought in Brazil is described. Not only is the lack of water a problem, there is also the problem of catastrophic flooding when rain does occur in this area of Brazil. In spite of these difficulties, large tracts of the region's land are used for raising livestock and farming. The Sao Francisco is the only river flowing through the semi-arid northeast which carries large volumes of water from the southeastern region of the country where rainfall is much more regular and more abundant. Two large reservoirs contribute considerably to the regulation of the river's flow, the Tres Marias and the Sobradinho. Watershed management plans will be combined with plans to store excess runoff of the flood seasons to transform many of the rivers of the northern half of the polygon of drought from seasonal to perennial rivers and thus provide the basis for large scale irrigation projects. Two basic plans are currently being considered. The first plan calls for diversion of part of the wet season runoff from the Sao Francisco to the north. According to estimates, about 780,000 ha in the semi-arid region north of the Sao Francisco would be suitable for farming by irrigation if water were available without limitation. Roughly 140,000 ha could be irrigated from locally existing sources. The overall development would take decades and be one of the largest single irrigation projects ever completed. (Baker-FRC)
W82-01744

LOW ENERGY PRECISION APPLICATION (LEPA) IRRIGATION SYSTEM,
Texas Agricultural Experimental Station, Lubbock.
W. M. Lyle, and J. P. Bordovsky.
Transactions of the ASAE Vol 24, No 5, p 1241-1245, September-October, 1981. 6 Fig, 1 Tab, 11 Ref.

Descriptors: *Irrigation practices, Design criteria, Rainfall, Runoff, *Irrigation design, Rainfall-runoff relationships, *Furrow irrigation.

A new concept in irrigation system design is introduced, along with a report of preliminary results. The system is characterized by and has been labeled as a low energy precision application (LEPA) system, which rather than spraying water into the air at moderate to high pressures, distributes it directly to the furrow at very low pressure through drop tubes and orfice controlled emitters. The system continuously moves through the field in a linear fashion. It is used in conjunction with micro-basin land preparation, which also optimizes the utilization of rainfall by minimizing runoff. The combined system was designed to minimize the effect of soil and climatic variables which adversely influence furrow and sprinkler irrigation efficiencies. From the results of testing thus far completed, it appears that significant savings in both water and energy resources are indicated. The system has been evaluated in terms of irrigation efficiency, water use efficiency (yield per gross unit of water delivered to the field), and energy conservation. (Baker-FRC)
W82-01859

DRIP IRRIGATION UNIFORMITY CONSIDERING EMITTER PLUGGING,
Michigan State Univ., East Lansing. Dept. of Agricultural Engineering.
V. F. Bralts, I. P. Wu, and H. M. Gitlin.
Transactions of the ASAE, Vol 24, No 5, p 1234-1240, September-October, 1981. 6 Fig, 1 Tab, 16 Ref.

Descriptors: *Drip irrigation, Irrigation practices, Mathematical studies, Statistical analysis.

The present research is an attempt to statistically include emitter plugging in the calculations for uniformity of single and dual chamber drip irrigation lateral lines. The theoretical development of orifice type emitter flow variation due to partial and/or complete plugging is discussed. Through the examples provided the study showed that emitter plugging can be statistically included in the

calculations of uniformity of emitter flow of single and dual chamber drip irrigation lateral lines. In addition, the number of emitters per plant has been shown to be important when calculating uniformity of emitter flow, including emitter plugging. The inclusion of emitter plugging in drip irrigation design enables the design engineer to assess the ramifications of potential plugging on uniformity of emitter flow and ultimately on crop yields. The various system design requirements such as irrigation water filters, lateral line chemical treatment and lateral line flushing can be balanced with acceptable levels of emitter plugging and uniformity. Furthermore, remedial measures such as increased irrigation time or lateral line replacement could be made when uniformity decreases below acceptable limits. Design curves and nomographs have been developed which simplify the inclusion of emitter plugging in design of drip irrigation lateral lines. These design charts are based upon the statistical uniformity coefficient. Similar charts can be easily developed for other uniformity measures. (Baker-FRC)
W82-01860

EFFECT OF IRRIGATION PRACTICES AND METHODS OF SOWING-CUM-IRRIGATION ON THE PERFORMANCE OF SAFFLOWER,
Central Soil Salinity Research Inst., Karnal (India).
R. K. Rajput, S. N. Singh, J. S. Yadav, and B. M. Sharma.
Indian Journal of Agricultural Sciences, Vol 51, No 5, p 316-320, May, 1981. 4 Tab, 8 Ref.

Descriptors: *Crop yield, *Irrigation effects, *Furrow irrigation, Irrigation practices, Crop production, Agriculture, Statistical analysis, India, *Safflower.

A field experiment was conducted to determine the most sensitive growth stage of safflower for moisture stress and to determine the best method of sowing vis-a-vis irrigation for good seed yield and water economy. Treatments included combinations of eight post-sowing irrigation schedules based on crop growth stages and four methods of sowing-cum-irrigation. The relationship between post-sowing irrigation schedules and methods of sowing-cum-irrigation was not statistically significant during both seasons of the experiment as well as in the pooled analysis. Irrigation at any growth stage was beneficial, and the effect was pronounced when irrigation was applied at the flowering stage followed by irrigation at the milk stage. At the test site where the soils are deep, highly moisture retentive, and medium textured, safflower can successfully be grown with row spacing of 50 cm and alternate furrow irrigation. Irrigations applied at the flowering stage and the milk stage will ensure a yield of about 2700 kg/ha. (Small-FRC)
W82-01878

CONTROL OF PEACH TREE GROWTH AND PRODUCTIVITY BY REGULATED WATER SUPPLY, TREE DENSITY, AND SUMMER PRUNING,
Victoria Dept. of Agriculture, Tatura (Australia). Irrigation Research Inst.
For primary bibliographic entry see Field 2I.
W82-01883

INTRASEASONAL WATER ALLOCATION IN DEFICIT IRRIGATION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
R. L. Bras, and J. R. Cordova.
Water Resources Research, Vol 17, No 4, p 866-874, August, 1981. 6 Fig, 3 Tab, 18 Ref.

Descriptors: *Water requirements, *Irrigation requirements, *Crop yield, *Water allocation, Model studies, Stochastic process, Soil moisture deficiency, Cost-benefit analysis, Economic aspects, Profit, Evapotranspiration.

An optimal irrigation policy is derived by applying a model which considers the intraseasonal stochastic variance in crop water requirements and the dynamics of the soil moisture depletion process. The goal of the simulation is maximum profits. General expressions are derived analytically for computing the first two moments of the soil moisture content and of total actual evapotranspiration. The conditional probability distribution of soil moisture content at the end of each decision stage and the associated first moment of the total actual evapotranspiration are used within a stochastic control algorithm, using dynamic programming, to obtain the solution. Among the assumptions required are: lumped soil system, deterministic potential evapotranspiration and irrigation water supply, one crop, simplistic rainfall model, soil moisture averaged through depth, and unquantified farmers' risk aversion. A case study of corn growing on Nunn clay loam soil in Colorado in 1974 is used to test the model. The 120-day growing season is divided into 15 eight-day decision stages and the optimal water allocation solved for limited and unlimited water cases. Results are depicted in graphs plotting net benefits (Dollars per acre) vs. available irrigation water at the root zone (mm) when the cost of irrigation water is $0.16 per mm. (Cassar-FRC)
W82-01916

RESPONSES OF GRAIN SORGHUM TO VARIABLE WATER SUPPLY UNDER TWO IRRIGATION FREQUENCIES,
California Univ., Davis. Dept. of Land, Air, and Water Resources.
J. M. Faci, and E. Fereres.
Irrigation Science, Vol 1, No 3, p 149-159, 1980. 6 Fig, 2 Tab, 19 Ref.

Descriptors: *Sorghum, *Irrigation efficiency, *Water stress, Sprinkler irrigation, Basin irrigation, Soil-water-plant relationships, Evapotranspiration, Crop yield, Grain crops.

Sorghum bicolor L. Moench Cv. Pioneer 846 was grown during 1977 in deep loam soil under different irrigation regimes. Treatments were: Experiment I--sprinkler irrigation; initial soil condition, dry; water application at 2 day intervals or at 10-14 day intervals; Experiment II--basin irrigation; initial soil conditions, fully wetted; water applications at 1 week intervals or nonirrigated. Seasonal amounts of water applied were between 5.1 and 77.0 cm. Linear relationships were found of both total dry matter production and grain yield to seasonal evapotranspiration in both variations of Experiment I. Grain yield and dry matter production were the same with both irrigation frequencies when the evapotranspiration values were near potential. At low evapotranspiration values the Experiment I low frequency irrigation yielded more grain and dry matter than did the Experiment I high frequency irrigation. Higher frequency irrigation allowed more water evaporation from the soil and less recovery from water stress. Grain yields were higher for a similar evapotranspiration in Experiment II weekly irrigation than for Experiment I. (Cassar-FRC)
W82-01944

CORN AND ALFALFA PRODUCTION AS INFLUENCED BY LIMITED IRRIGATION,
Utah State Univ., Logan. Dept. of Soil Science and Biometeorology.
A. Retta, and R. J. Hanks.
Irrigation Science, Vol 1, No 3, p 135-147, 1980. 9 Fig, 7 Tab, 10 Ref.

Descriptors: *Grain crops, *Irrigation practices, *Evapotranspiration, Model studies, Corn, Alfalfa, Crop yield, Water stress, Varieties, Hanks model, Irrigation efficiency, Logan, *Utah.

Six varieties of corn and three varieties of alfalfa were grown under varying degrees of irrigation in two seasons (1976 and 1977) at Logan, Utah. Dry matter yields and, in most cases, grain yields, showed a linear relationship to evapotranspiration. There was little difference in yields among the varieties. The slopes of the regression lines (relative dry matter and grain yields:relative evapotranspiration) varied considerably between the 2 years but not among varieties. The slope in alfalfa changed less than in corn, partly as a result of the lesser degree of soil evaporation in alfalfa. Yields predicted by Hanks' (1974) water balance computer model to estimate dry matter and grain yields of field crops from inputs of standard soils, weather, and plant data agreed well with measured yields for both grains. (Cassar-FRC)
W82-01945

DEVELOPMENT OF SOLUTIONS FOR LEVEL-BASIN DESIGN,
Science and Education Administration, Phoenix, AZ. Water Conservation Lab.
A. J. Clemmens, T. Strelkoff, and A. R. Dedrick.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 265-279, September, 1981. 3 Fig, 3 Tab, 22 Ref.

Descriptors: *Irrigation efficiency, *Distribution, *Basin irrigation, Irrigation design, Spatial distribution, Infiltration, Level basin design, Water conservation.

This paper discusses methods of estimating distribution uniformities for a wide variety of flow rates, run lengths, infiltration characteristics, and flow resistances for the design and management of irrigation in level basins. An example illustrates the use of the method in applying a given depth of water (4 inches) everywhere in a field at a desired uniformity (80%). It was seen that halving the run length can almost triple the basin area without sacrificing any uniformity. If the run length is decreased for a given basin area, distribution uniformity is greatly improved and the amount of applied water decreased. For a shorter basin, the distribution uniformity does not respond as drastically to changes in flow rate. (Cassar-FRC)
W82-01976

OPTIMAL DESIGN OF BORDER IRRIGATION SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. M. Reddy, and W. Clyma.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 289-306, September, 1981. 3 Fig, 4 Tab, 13 Ref.

Descriptors: *Border irrigation, *Irrigation requirements, *Crop yield, Profit, Water conservation, Optimization, Surface irrigation, Economic aspects, Water requirements, Model studies, Basin irrigation, Cost-benefit analysis.

An optimal border irrigation system design was developed to obtain maximum profits within the system constraints and variables. A two-step process established the relationship between yield and design variables. First, a hydraulic model determined the relationship between water requirement efficiency and the design variables. Second, a crop production model and the hydraulic model determined the relationship between crop yield and water requirement efficiency. These two relationships were combined with a mathematical programming technique. The model considered produce values and the costs of labor, water, ditch construction, and crop production, but not the negative effects of runoff and deep percolation. Design variables included were inflow rate, time of inflow, length of run, number of lengths of run, border width, and number of border widths. Graded borders and level basins were considered separately. This technique provides both the optimum management techniques for given field conditions and optimum design for new systems. (Cassar-FRC)
W82-01977

INFLUENCE OF TRICKLE AND SPRINKLE IRRIGATION ON GOLDEN DELICIOUS APPLE QUALITY,
Irrigated Agriculture Research and Extension Center, Prosser, WA.
S. R. Drake, E. L. Proebsting, Jr., M. O. Mahan, and J. B. Thompson.
Journal of the American Society for Horticultural Science, Vol 106, No 3, p 255-258, May, 1981. 4 Tab, 12 Ref.

Descriptors: *Apples, *Sprinkle irrigation, *Trickle irrigation, Irrigation practices, Fruit crops, Trees, Soil-water-plant relationship, Water use efficiency, Crop yield, *Irrigation efficiency.

Trickle irrigation of Golden Delicious apples (Malus domestica Borkh.) resulted in a generally higher quality product than did sprinkle irrigation in studies conducted in Washington during 1978 and 1979. Comparisons in growing regimes of trickle and sprinkle plots, respectively, were as follows: total water applied, 38 and 71 cm in 1978, 46 and 91 cm in 1979; leaf water potentials, -14 and -12 bars in 1978, -12 and -11 bars in 1979. In the trickle plots the soil remained moist in a 1.5 meter diameter circle around each tree, but reached the permanent wilting point in June. Differences in crop yields were not significant. Trickle-irrigated apples matured earlier, produced applesauce of better consistency, showed less weep of thawed frozen slices, and were higher in yellow color, soluble solids, and pH. Sprinkle-irrigated apples after 5 months storage were of higher eating quality (juicier and with lower soluble solids/titratable acidity ratio). Frozen apple slices from sprinkle irrigation plots were firmer. (Cassar-FRC)
W82-02001

AGRICULTURAL CONSERVATION PROGRAM: AN EVALUATION,
Agricultural Stabilization and Conservation Service, Washington, DC.
J. R. Henry.
Water Resources Bulletin, Vol 17, No 3, p 438-442, June, 1981. 1 Tab.

Descriptors: *Cost sharing, *Agricultural conservation Program, *Conservation, Economic aspects, Water policy, Water conservation, *Soil conservation, *Irrigation, Ponds, Erosion control, Forestry, Agriculture, Farms.

The Agricultural Conservation Program (ACP) authorizes cost sharing with land owners for projects to conserve water, soil, and wildlife and for agriculture-related pollution prevention and control. This paper summarizes Phase I of the appraisal of this program, concentrating on soil and water conservation, and excludes wind erosion, water quality, changes in productive capacity, wildlife habitats, and offsite impacts. Information was collected from 171 counties in 46 states, 5% of all counties, for a total of 60,836 cases. Overall results show that the ACP is doing a very good job in meeting its stated purposes, but effectiveness can be improved with planning and greater use of scientific tools such as soil maps and the Universal Soil Loss Equation. More than 52% of shared cost erosion control projects were installed on land with low erosion rates, less than 5 tons per acre per year; only 27% on land eroding at high rates, 5-14 tons per acre per year. Almost 63% of irrigation water practices were applied to lands receiving 4 ft or less per acre per year; 34% to lands receiving 4-8 ft per acre per year; and 4% to lands receiving 8 ft per acre per year or more. The 4% accounted for over 33% of total volume of water conserved. As the capacity of impoundments increased, costs per acre foot of storage capacity declined and costs per acre increased. (Cassar-FRC)
W82-02019

WATER USE, YIELD AND QUALITY OF RAPESEED AS INFLUENCED BY SPACING, IRRIGATION AND TIME OF HARVEST WHEN RAISED IN A MULTIPLE-CROPPING SYSTEM,
Chandra Shekhar Azad Univ. of Agriculture and Technology, Kanpur (India).
S. Bhan, M. Balaraju, and V. Ram.
Indian Journal of Agricultural Sciences, Vol 50, No 10, p 760-763, October, 1980. 2 Tab, 7 Ref.

Descriptors: *Irrigation requirements, *Rapeseed, *Water requirements, Water conservation, Agriculture, *India, Irrigation efficiency.

Water use efficiency of a rapeseed crop was greatest (4.60 kg grain per mm water in 1976-77 and 6.85 kg per mm in 1977-78) using two irrigations, at flower initiation and at pod development. Water use for this regime was 206.3 mm in 1976-77 and 212.2 mm in 1977-78. In 1976-77 and 1977-78 unirrigated fields produced 3.6 and 4.24 kg grain per mm water, respectively, using 134.2 and 127.6 mm of water, respectively. Water use efficiency for one irrigation at flower initiation was 4.46 kg per mm in 1976-77 and 5.73 kg per mm in 1977-78; for one irrigation at pod development, 3.53 kg per mm in 1976-77 and 5.14 kg per mm in 1977-78. Harvest of rapeseed at physiological maturity did not adversely affect yield, although the 1000 grain weight and percent oil were very slightly higher for the more mature crop. The two-week earlier rapeseed harvest facilitated sowing of a late wheat crop. (Cassar-FRC)
W82-02031

SHORTENING THE IRRIGATION INTERVAL AS A MEANS OF SAVING WATER IN A BANANA PLANTATION,
Volcani Inst. of Agricultural Research, Bet-Dagan Israel). Div. of Subtropical Horticulture.
E. Lahav, and D. Kalmar.
Australian Journal of Agricultural Research, Vol 32, No 3, p 465-477, 1981. 7 Fig, 8 Tab, 9 Ref.

Descriptors: *Irrigation practices, *Water conservation, Agricultural engineering, Farming, *Bananas, Arid climates, *Israel, Soil-water-plant relationships.

Information was sought on the effect of irrigation intervals and water amounts on the water and salt distribution in the soil profile and on the nutrient concentration in the leaf lamina and petiole of the banana sucker. The experimental site was located in the northern coastal plain of Israel. The soil was a brown low-lime grummusol. Organic matter was 1.0% and the nitrate level was 25 ppm. Wetting cycle treatments were irrigation at 3-day intervals and pulsed irrigation. The different treatments considerably affected the wetted soil volumes, with the effect of the water quantity being greater than that of the irrigation interval. The relationship between the wetted soil volumes and the yield showed that the lowest yield was obtained from suckers irrigated with a reduced water amount once in 3 days. Irrigation with the same water amount but by pulses increased the wetted soil volume, shortened the period of water stress, and therefore increased yields. The regular water amount applied at 3-day intervals resulted in the largest wetted soil volume, but the water stress period was considerably longer than that with the same water amount given by pulses, thus lowering the average yield. An increase in water tension at the lower layer in treatments by irrigated pulses showed that no water excess reached this layer. However, the increase in tension in the lower soil layer did not result in any negative effect on the sucker development, its roots, or its yields. During the 3-day interval between irrigation treatments, the upper soil layer was drying out and, due to the water consumption of the sucker increasing during the season, the water tension before irrigation increased. In cases of wide spacing, water loss was due to evaporation. With narrow planting distances, water loss was due to plant uptake. It was concluded that shortening the interval between periods of irrigation may be a good means of saving water. (Baker-FRC)
W82-02093

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

PARISH IS NOT LIABLE FOR SUBSIDENCE.
For primary bibliographic entry see Field 6E.
W82-01603

RECENT CHANGES IN LEVEL OF LAKE VICTORIA,
Hydrometeorological Survey of the Catchments of Lakes Victoria, Kyoga and Mobutu Sese Seko, Entebbe (Uganda).
G. W. Kite.
Hydrological Sciences Bulletin, Vol 26, No 3, p 233-243, September, 1981. 5 Fig, 3 Tab, 9 Ref.

Descriptors: *Lakes, *Dams, *Water level, Rivers, Streamflow, *Lake Victoria, Precipication, Evaporation, Water level fluctuations.

Under natural conditions, the outflow from Lake Victoria was controlled by the Ripon Falls in the Victoria Nile at Jinja. Following construction of the Owen Falls Dam, these falls have become partially submerged. The center portion of the falls was removed, so that today there is subcritical flow in the center of the river and supercritical flow on each side over the remains of the rapids. The excesses and shortages are volumes of water and, when divided by the areas of Lake Victoria corresponding to the appropriate levels, can be converted to depths over the lake, thus apparently establishing the effects of the Owen Falls dam on the level of Lake Victoria. The components of the water balance of Lake Victoria are, in order of decreasing importance, rainfall over the lake, evaporation from the lake, outflow from the lake, and runoff from the surrounding land areas. During the period from 1961 to 1964, the level of Lake Victoria rose by about 2.5 meters; over the period 1977 to 1980 it rose by around 1.5 meters. These rises are unusual, given the normal small variation of such a large lake. Use of a lake routing model has shown that the most recent rise in lake level can be simulated very closely if the observed precipitation volumes are increased by between 25 and 30%, suggesting that the observed data may be underestimates of the true precipitation. Rapid changes in lake levels and river flows such as those described here render the use of long term average statistics unreliable for design purposes. (Baker-FRC)
W82-01711

THE CHAMBAL PROJECT: PROBLEMS AND SOLUTIONS,
Madhya Pradesh Irrigation Dept., Bhopal (India).
D. S. Sinha.
International Water Power and Dam Construction, Vol 33, No 8, p 25-28, August, 1981. 3 Fig.

Descriptors: *Irrigation programs, *Flood control, *Drainage, *Chambal Project, *India, Civil engineering, Madhya Pradesh, Engineering, Soil water, Weed control, Waterlogging, Construction, Canal construction.

The Chambal Project serving Madhya Pradesh, India, is described. Three dams and 350 km of major canals supply this irrigation project. The purpose of the project was to offer protection from heavy flooding in the area. It became obvious that a large flood reserve would have to be maintained in the reservoir, with a corresponding loss of useful capacity, if proper utilization of the monsoon waters was to be achieved. Breaches in the Chambal canal also created problems for the area. Weed growth in the canal compounded the breaching problem, reducing the canal's carrying capacity. With the advent of irrigation and constant flow of the canal water, large areas became water-logged. Where irrigation is introduced for the first time, a rise in the groundwater table is expected. If surface and subsurface drainage are lacking, when water oozes out from the canal embankment or leaks through the subsoil, the waterlogging problem becomes enormous. The Chambal project was visualized in the early 1950s and planned an irrigation intensity of 70% of the cultivable area. However, factors made the amount of water this was able to supply inadequate to the need. Farmers started growing high yielding wheat instead of the normal variety. The higher yielding crop required significantly greater amounts of water. When they farmed all the area available, instead of the predicted 70% of it, again demand exceeded supply. Night irrigation was not being carried out, and during these hours water was allowed to go to waste into the drains. Problems have been somewhat overcome by ending canal weed problems, strengthening the canal embankments, and land levelling and land shaping. (Baker-FRC)
W82-01739

USING THE BAMBOO (BAMBUSA VULGARIS) AS FIELD DRAINAGE MATERIAL,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Agricultural Engineering.
E. U. Nwa.
Transactions of the ASAE, Vol 24, No 4, p 974-976, July/August, 1981. 3 Fig, 1 Tab, 11 Ref.

Descriptors: *Drainage, *Irrigation practices, *Nigeria, *Bamboo, Water table, Rainfall, Runoff, Waterlogging, Salinity, Subsurface drainage, Surface drainage.

The bamboo was tested as an inexpensive material for making field drains. A set of uniform bamboo pipes was cut into 4 meter lengths. The septum at the nodes was removed by boring through. Holes were drilled evenly spaced around each pipe. Two parallel drains, 20 meters long (i.e., 5 pipes each), were installed across the slope of a sloping test field at a spacing of 15 meters. The depth of the drain was one meter and the slope was 0.2%. Crushed stones, about 6.5 mm in diameter, were used as envelope material. The depth of the water table below the ground surface was measured in the ground water tubes a day or two after each rainfall and at weekly intervals during long rainless periods. At the peak of the rains the stream water at the lower end of the slope backed into the evacuation ditch up to the position of the lower drain, rendering it less effective. In general, the two drains proved fairly effective. The outflow rate naturally increased with the amount of rainfall. It also responded to the rainfall intervals, increasing, decreasing or remaining constant depending on the intervals. The maximum drain outflow rate of 32 liters/minutes was obtained between the end of July and the end of September. Rainfall was very regular during this period. It was concluded that bamboo can be used effectively for field drainage. (Baker-FRC)
W82-01743

STAGE-DISCHARGE RELATIONS AT DAMS ON THE ILLINOIS AND DES PLAINES RIVERS IN ILLINOIS,
Geological Survey, Urbana, IL. Water Resources Div.
D. M. Mades.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $8.25 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-1009, 1981. 56 p, 19 Fig, 23 Tab, 11 Ref.

Descriptors: *Stage-discharge relations, *Dams, *Streamflow, *Regulated flow, Concrete dams, Movable dams, Slide, Radial gates, Locks, Outlets, Orifice flow, Model sutides, Discharge coefficients, Discharge measurement, Gaging station, *Illinois, Illinois River, Des Plaines River.

Stage-discharge relations were developed for the Brandon Road Dam on the Des Plainse River and the Dresden Island, Marseilles, Starved Rock, Peoria, and La Grange Dams on the Illinois River. At Brandon Road Dam, streamflow is regulated by the operation of tainter gates and headgates. Tainter gates are operated to regulate streamflow at the Dresden Island, Marseilles, and Starved Rock Dams. Peoria Dam and La Grange Dam comprise timber Chanoine wickets which are lowered to a horizontal position on the streambed when used for streamflow regulation. Both dams have concrete abutments housing butterfly valves that are also used for regulation. A total of 50 discharge measurements ranging from 49.0 to 2,450 cubic meter per second were used to determine discharge coefficients in equations expressing discharge as a function of headwater depth, tailwater depth, and gate opening. A stage-discharge relation for Chanoine wicket dams developed from a U.S. Army Corps of Engineers hydraulic model study in 1937 and 1938 was verified with discharge measurements made downstream from the Peoria and La Grange Dams. (USGS)
W82-01793

ECOLOGICAL CHARACTERISTICS OF THE RHIZOSPHERE MICROFLORA OF MYRIOPHYLLUM HETEROPHYLLUM,
Massachusetts Univ., Waltham. Department of Environmental Science.
J. R. Blotnick, J. Rho, and H. B. Gunner.
Journal of Environmental Quality, Vol 9, No 2, p 207-210, April/June, 1980. 1 Fig, 3 Tab, 26 Ref. OWRT-B-066-MASS(1), 14-34-0001-9075.

Descriptors: *Aquatic weed control, *Rhizosphere, *Nitrogen fixing bacteria, Weeds, Plant growth, Aquatic weeds, Aquatic plants, Nutrients, *Mesotrophic lakes, Aquatic bacteria, Aquatic productivity, Surface water, Species composition, Population density, Cycling nutrients.

There has been an increased interest in the growth patterns and nutrient requirements of vascular plants as problems associated with nuisance weed growth in aquatic environments increased. During periods of active plant growth, bacterial populations associated with the rhizosphere and rhizoplane of the water milfoil, Myriophyllum heterophyllum, were examined in the littoral zone of a softwater, mesotrophic lake of Massachusetts. Species composition of the rhizoplane bacteria differed markedly from that of adjacent sediments; however, the population density of heterotrophic bacteria in each of these sites was similar. In the rhizoplane, large populations of bacteria capable of reducing nitrate and performing ammonification were found. Nitrogen-fixing activity was significantly greater on root surfaces than in lake sediments. Intense rhizosphere activity was linked to the bimodal productivity cycle of M. heterophyllum. It was suggested that the large populations of rhizoplane bacteria involved in nutrient transformations may more readily supply aquatic plants with available nutrients than do the nonrhizosphere populations. (Geiger-FRC)
W82-01796

BIOLOGICAL CONSEQUENCES OF STREAM ROUTING THROUGH A FINAL-CUT STRIP MINE PIT: BENTHIC MACROINVERTEBRATES,
Argonne National Lab., IL.
W. S. Vinikour.
Hydrobiologia, Vol 75, No 1, p 33-43, October 4, 1980. 1 Fig, 7 Tab, 47 Ref.

Descriptors: *Macroinvertebrates, *Diversion, *Stream biota, Land reclamation, Lakes, *Goose Creek, *Wyoming, Benthic fauna, Streams, Mayflies, Midges, Tubificids, Coal mining, Aquatic life, Benthos, Strip mine lakes, Water quality.

Rerouting Goose Creek near Sheridan, Wyoming, through a final-cut strip mine pit (650 meters x 350 meters at the widest) to reach the coal reserves beneath the stream bed disrupted the normal riffle/pool sequence, forming a lake-type habitat. A study of the macrobenthos in the pit revealed a change from dominance by net-spinning hydropsychids and mayflies to dominance by tubificid worms (Limnodrilus hoffmeisteri) and midge larvae (Chironomus sp., Procladius sp., and Tanypus stellatus). A few other insects which drifted in from the creek were found in the upstream portion of the pit. None occurred in the downstream portion because of fish predation or unfavorable habitat. The pit, which receives sewage effluent and agricultural runoff, helps to improve water quality. The water leaving the pit has lower diurnal oxygen sags, ammonia-N concentrations, and fecal coliform levels than the entering water. (Cassar-FRC)
W82-01948

STREAMLINED REGULATIONS COULD HELP MAKE NEW STORMWATER MANAGEMENT CONCEPTS PART OF THE TRADITION,
C. R. Curtis, and R. C. Hinde.
Water and Pollution Control, Vol 119, No 8/9, p 22-23, 37, August/September, 1981. 2 Fig, 13 Ref.

Descriptors: *Storm water, *Water managment, Legal aspects, Regulations, Administrative regulations, Decision making, Computer models, Model studies, *Flood control, *Toronto.

Shortly after Hurricane Hazel reached the Metropolitan Toronto area in 1954 the Metropolitan Toronto and Region Conservation Authority was formed with the aim of acting as a strong, constructive force for flood control, to protect people and property from flooding. By 1971 an ambitious program of problem identification, analysis, and implementation had begun. Stormwater quality problems were identified and the basic data was gathered from observations at test catchments. Analytical numeric tools were developed to model both quality and quantity of stormwater. The most significant computer program resulting from this research was a version of the Storm Water Management Model, modified for Canadian conditions: CANSWMM. While the analytical techniques were being developed, training seminars for the people who would be involved in stormwater management modeling proceeded. Various computer models were explained. Some municipalities prepared Storm Drainage Criteria Manuals as guides for the development within their bounds. Local conservation implementation of stormwater management is often complicated by existing legislation and common law, as well as by government policy. The rights and obligations of municipalities and landowners must be considered in the design and implementation of any stormwater management scheme. Overlapping of jurisdictions is also a problem in legislation affecting stormwater management. It is hoped that the legal, procedural, and policy problems will soon be resolved so that stormwater management can move ahead. (Baker-FRC)
W82-02000

THE DAY THAT THE RAIN CAME DOWN,
For primary bibliographic entry see Field 2E.
W82-02064

4B. Groundwater Management

OPERATING POLICIES FOR A SURFACE/GROUND WATER SYSTEM,
Birmingham Univ. (England). Dept. of Civil Engineering.
K. R. Rushton, and L. M. Tomlinson.
Water Resources Bulletin, Vol 17, No 3, p 406-413, June, 1981. 5 Fig, 4 Tab, 20 Ref.

Descriptors: *Safe yield, *Conjunctive use, *Reservoir operation, *Groundwater management, Carbonate aquifers, Transmissivity, Groundwater recharge, Recharge, Springs, Simulation analysis, Lincolnshire Limestone aquifer, *England.

Conjunctive use of a hypothetical surface reservoir, storage volume 20,000 megaliters, and the Lincolnshire Limestone aquifer in eastern England was simulated. In this aquifer water enters in the outcrop region and flows toward the confined aquifer in which the wells are located. Storage coefficients and transmissivities vary widely in different sections. Fissures developed by solution permit excess water to flow from springs. Five alternative operating policies were considered for the period 1961-77. Greatest safe yield (or maximum constant yield) was 123 megaliters per day (22,600 gal per min), using combined control rules for reservoir and aquifer by a combined simulation. Other options produced safe yields of 84 to 118 megaliters per day. Extending the 17 year data to 100 years gave a maximum safe yield of 120 megaliters per day. Excluding the critical dry year, 1976, simulations showed a maximum yield of 162 megaliters per day. This illustrates that the method is very sensitive in input. (Cassar-FRC)
W82-01741

4C. Effects On Water Of Man's Non-Water Activities

LONG TERM RESPONSES OF STREAMFLOW FOLLOWING CLEARCUTTING AND REGROWTH,
Southeastern Forest Experiment Station, Asheville, NC. Coweeta Hydrologic Lab.
L. W. Swift, Jr., and W. T. Swank.

Hydrological Sciences Bulletin, Vol 26, No 3, p 243-256, September, 1981. 2 Fig, 4 Tab, 13 Ref.

Descriptors: *Stream discharge, *Forest management, *Clear-cutting, Cutting management, Forest watersheds, Forestry, Forests, Revegetation, Reforestation, Vegetation establishment, Runoff, Streamflow, North Carolina, Experimental basins.

Three experimental basins were maintained at Coweeta Hydrologic Lab in western North Carolina. Two basins were totally clearcut without removal of forest products - one of them twice, while the third was a forest management demonstration and received a mix of thinning, clearcutting, and noncutting. Changes in streamflow immediately after cutting and as the forest regrew are reported and related to variations in vegetation, climate and basin elevation. The results of the study clearly indicated that streamflow from mountain basins increases when the forest is cut, and that these increases decline as the vegetation regrows. The data from the study allow closer examination of the factors influencing the trend line equations fitted to streamflow increases. Vegetative regrowth is the dominant change occurring after the forest is cut on a basin and thus is the prime determinant of the trend lines for the Coweeta experiments. The most significant finding was that the slopes of the trend lines were essentially identical for all cases, despite the fact that these experiments involved different sets of years, different degrees of cutting, and basins with distinctly different physiography and elevation. Climatic variation was the most likely cause for departures of streamflow increases from the smooth trend line. The mixed hardwood forest of one basin was clearcut twice in the past 40 years. During the second regrowth period, streamflow increased after the first year at about one half the increases at the same points in time after the first treatment. Variability of flow seemed partly related to precipitation. (Baker-FRC)
W82-01610

HYDROLOGY OF OKARITO LAGOON AND THE INFERRED EFFECTS OF SELECTIVE LOGGING IN OKARITO FOREST,
Forest Research Inst., Christchurch (New Zealand).
J. M. Macpherson.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 25-39, 1981. 11 Fig, 14 Ref.

Descriptors: *Logging, *Suspended sediment, *Diversion, *Estuaries, Rivers, Lagoons, Ecological effects, Hydrology, Hydrologic budget, Okarito Lagoon, *New Zealand.

The relative impact of selective logging and the Waitangi-taona River diversion on Okarito Lagoon were assessed. The hydrology of the 20 sq km estuary was determined. The diversion of the Waitangi-taona River in 1967 may be responsible for the fact that the surface sediment was consistently muddier than the subsurface sediment. Most sediment is supplied by river or erosion of tidal channel margins. Freshwater inflows into the lagoon vary from less than 11 cu m/sec to more than 750 cu m/sec during storms. When the estimated yield and water inflow effects of the 1967 river diversion are compared with the short-term effects of selective logging, the effects of logging on sediment yield, water balance, and dissolved solids inputs should be small. If there are future studies of the ecological impact of physical changes in the lagoon and its catchment, the 1967 diversion should receive the most attention. (Small-FRC)
W82-01703

THE EFFECTS OF MAN ON BASIN RUNOFF, AND ON THE WATER BALANCE AND WATER STAGE OF THE CASPIAN SEA,
Gosudarstvennyi Gidrologicheskii Inst., Leningrad (USSR).
I. A. Shiklomanov.
Hydrological Science Bulletin, Vol 26, No 3, p 321-328, September, 1981. 4 Fig, 1 Tab, 3 Ref.

Descriptors: *Basin irrigation, *Hydrologic budget, Water demand, Water supply, Irrigation effects, Environmental effects, *Caspian Sea, Rivers, Runoff, *Water level fluctuations, *Sea level.

An assessment of the role of man's activities on governing the changes in inflows and sea stage was made to begin to ascertain the measures needed to solve the problems of the Caspian Sea. The main rivers flowing into the Sea are the Volga, Ural, Kura, Terek, Sulak, and Samur. The principal effects of man in the basins of these rivers from the point of view of runoff include construction and operation of reservoirs, irrigation, agrotechnical measures, and industrial and municipal water consumption. Investigations of long-term runoff fluctuations based on data from hydrometeorological sites were made, together with an analysis of changes in natural meteorological factors and the development of economic activity in the basins. Water balance estimations were also made, based on the study of water balance components in basin sub-areas where changes in evaporation and flow formation conditions occur due to man's activity. According to the data analyzed, the regime of surface inflow into the sea was practically natural until 1940, when a man-induced reduction of inflow occurred, amounting to 6.3 cubic kilometers/year, or 2.2% of the natural surface inflow. At present the inflow reduction is 38 cubic kilometers per year, or 13%. It appears in the future that this reduction will increase to 65-70 cubic kilometers per year, or 23% of the natural inflow. During 1955-1973 the construction and operation of reservoirs was the main problem. Now irrigation demands play the major role. By the end of this century, two-thirds of the reduction in total runoff to the sea will result from irrigation, due to the area of the basin being irrigated. If climatic conditions are average and if the effects of man's activities continue, the sea level is expected to decrease gradually to 29.5 meters above mean sea level by the end of this century. (Baker-FRC)
W82-01709

4D. Watershed Protection

RECONSTRUCTION OF A SMALL DAM FOR A RECREATIONAL LAKE.
Public Works, Vol 112, No 9, p 113-115, September, 1981. 5 Fig.

Descriptors: *Lakes, *Recreation facilities, Swamps, Erosion, Dams, Earth dams, Construction, Dam construction, Construction methods, Economic aspects, Management, *Erosion control, *Lake Lucerne, *New Jersey.

In Old Bridge Township, New Jersey, deterioration of a small dam on Lake Lucerne was resulting in increased sediment washing into the lake, and the resultant loss of the lake to the people for recreational purposes. Money was taken from a housing and community development grant to rehabilitate the dam and the surrounding 36.7 acres of woodland and marshland. Initially the design for the dam called for an elaborate concrete structure with a spillway. However, preliminary estimates indicated that the cost of such a structure would far exceed available monies. The final plan called for the establishment of a concrete wall of the dam and the placing of the outlet pipe in such a position as to allow increased fish and other aquatic life, which would then in turn take care of the mosquito problem. Local public works and recreation departments removed debris that had accumulated in parts of the lake over the years, including shopping carts, tires, boards and bottles. Several area residents were directed to clean up their properties which bordered the lake. The bottom of the lake was dredged to remove organic material and accumulated debris. The preconstruction meeting was held in April, 1980, and construction began in the latter part of the month. To reduce erosion, large riprap stone was placed on the sides of the spillway and on the downstream side at the pipe outlet. The stone was placed on top of a wire mesh and grouted. To provide access to the land around the lake the embankment over the outlet pipe was constructed 12 feet wide. Future work includes the construction of a foot bridge. The lake will remain a low-key recreational area open to area residents for nonpowered boating, fishing, hiking, bird-watching, and photography. (Baker-FRC)
W82-01604

HYDRAULIC TESTING OF PLASTIC FILTER FABRICS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 8G.
W82-01613

KINEMATIC FLOW APPROXIMATION OF RUNOFF ON A PLANE: AN EXACT ANALYTICAL SOLUTION,
Griffith Univ., Brisbane, Queensland (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 2A.
W82-01617

EROSION AND SEDIMENT CONTROL IN CHINA'S YELLOW RIVER BASIN,
A. R. Robinson.
Journal of Soil and Water Conservation, Vol 36, No 3, p 125-127, May/June, 1981. 1 Tab, 6 Ref.

Descriptors: *Fluvial sediments, *China, *Erosion control, *Terracing, *Diversion structures, Sedimentation, Sluices, Erosion, Accelerated erosion, Slope degradation, Loess, Check dams, Penstocks, Gully erosion, Gullies, Irrigation water, *Yellow River basin.

The Yellow River of China carries the largest sediment load of any river in the world, causing a soil loss of 12 tons/acre/year over the river's entire watershed. The loess plateau which constitutes about 60% of the Yellow River watershed has become heavily populated and farmed. About one-third of the soil of this area had been destroyed or badly damaged by erosion. Large gullies have been cut in the loess plateau and in some areas annual soil loss averages 45 tons/acre. About 10 to 40% of the precipitation runs off the heavily gullied land. The Sanmen Gorge Dam built on the Yellow River in 1960 has been plagued by sedimentation problems. In 1962, the Chinese began sluicing through the dam to reduce sediment deposition within the reservoir. In 1965, diversion tunnels were opened, and penstocks were converted to sluiceways. In 1970, additional diversion outlets were opened, and power generation was reduced to a third of that originally planned. Terracing and vegetative coverings are used to reduce erosion in the loess areas. Check dams or gully plugs help to contain runoff and sediment in gullies. Diverted flows laden with sediment are used for irrigation, and warping, a process of improving sandy soil, is practiced to increase farmland acreage. Great sediment loads in the middle and lower Yellow River continue to create challenging problems for water storage and the maintenance of reservoirs. (Geiger-FRC)
W82-01729

IMPRESSIONS OF SOIL AND WATER CONSERVATION IN CHINA,
Soil Conservation Service, Washington, DC.
P. M. Howard.
Journal of Soil and Water Conservation, Vol 36, No 3, p 122-124, May/June, 1981.

Descriptors: *Soil erosion, *China, *Water resources development, *Water supply development, *Irrigation water, Natural resources, *Soil conservation, Soil stabilization, Water reuse, Water use, Fertilizers, Irrigation, Irrigation practices, Water management, Water conservation.

Soil and water conservation practice in the People's Republic of China is going through a transition. Part of this change stems from modernization of land and farm management practices which call for more irrigation water. China also gives high priority to the use of water for navigation and has stepped up measures to improve drainage and control flooding. Although China has vast water resources, many rivers are not located near irrigable land, and their high sediment contents often cause flooding. During the last 30 years, many physical

structures have been built to help alleviate some of the problems. More work is needed on water reuse and spills. The rich sediment deposits of the Yellow River have been used for farmland. Until watershed erosion is controlled, the use of reservoirs for reducing flood peaks and trapping sediment will be limited. Mechanical parts are rapidly worn by the high sediment content of the water. Several critical sites along the Yellow River have been targeted for major erosion control programs. Revegetation has aided eroded areas that were destroyed by the rapid harvesting of forests. More collaboration between and research from national government, local government and academic organizations on erosion problems is needed. Human waste is often applied to vegetable crops grown near the cities; animal manure is composted with other organic materials and applied to mostly rice and cotton crops. Chemical fertilizers are being used increasingly where available. More progress in the better use of natural resources in China is expected through exchange of information with other countries. (Geiger-FRC)
W82-01730

CROP RESIDUE REMOVAL AND TILLAGE; EFFECTS ON SOIL EROSION AND NUTRIENT LOSS IN THE CORN BELT,
Science and Education Administration, Morris, MN. North Central Soil Conservation Research Lab.
For primary bibliographic entry see Field 2J.
W82-01770

THE LAKE TAHOE BASIN: A SYSTEMS ANALYSIS OF ITS CHARACTERISTICS AND HUMAN CARRYING CAPACITY,
Energy Policy Studies, Inc., Omaha.
For primary bibliographic entry see Field 6A.
W82-01807

EVALUATING SCOUR AT CULVERT OUTLETS,
Colorado State Univ., Fort Collins. Engineering Research Center.
J. F. Ruff, and S. R. Abt.
Transportation Research Record, No 785, p 37-40, 1980. 6 Fig, 3 Ref.

Descriptors: *Culverts, *Scour, *Erosion, Conduits, Sand, Gravel, Soil erosion, Energy dissipation, Channel scour, Conveyance structures, Design criteria, Erosion control.

The scour characteristics of uniform, noncohesive bed materials were studied in laboratory flumes. Two flume sizes were used: 6.1 m wide x 2.4 m deep x 30.5 m long and 1.2 m wide x 0.9 m deep x 4.6 m long. Test culverts were 100, 254, 356, and 457 mm in diameter. Scour holes in sand and gravel were similar in appearance. After 31 min the gravel scour hole was 85-90% of the full depth reached at 316 min and the sand scour hole was 80% of the depth reached at 316 min. The equations presented offer a refinement of existing methods for estimating the depth, length, width, and volume of scour holes. When culvert diameter, design discharge, and median diameter of the channel bed uniform material are known, the equations may be used to determine scour hole characteristics and to evaluate alternative scour protection methods and energy of dissipators. (Cassar-FRC)
W82-01934

AGRICULTURAL CONSERVATION PROGRAM: AN EVALUATION,
Agricultural Stabilization and Conservation Service, Washington, DC.
For primary bibliographic entry see Field 3F.
W82-02019

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

PLANNING WITH GREAT UNCERTAINTY: A REVIEW AND CASE STUDY OF THE SAFE DRINKING WATER CONTROVERSY,
Livingston Coll., New Brunswick, NJ. Dept. of Urban Studies.
M. R. Greenberg, and G. W. Page.
Socio-Economic Planning Sciences, Vol 15, No 2, p 65-74, 1981. 4 Tab, 59 Ref.

Descriptors: *Water pollution effects, *Public health, *Epidemiology, *Drinking water, New Jersey, Potable water, Chemical wastes, Organic compounds, Toxicity, Human population, Environmental policy, Future planning, Political aspects, Mortality, *Water treatment.

The monitoring of drinking water for toxic substances, especially organic pollutants, and the assessment of their risk to human health have become controversial environmental planning issues in the United States since 1974, when it was announced that people from Lousiana suffered high cancer risks from drinking Mississippi River water containing organic chemicals. A review is presented of the chemical contamination of potable water suppliesin the United States. The relation of polluted waters to the incidence of cancer is explored, and special attention is given to New Jersey, which has the highest rates of cancer mortality of any state in the country. When the US EPA carcinogenic potential coefficients were extrapolated to New Jersey potable water data, only 26 of 700 toxic chemicals found in United States water supplies were identified. Since relatively few suppliers provide most of the water supply of this state, the samples would have to be weighed by source and population in order to produce any significant relation to increased cancer risks. Improved monitoring of potable water supplies and more sophisticated epidemiological studies are needed to effectively solve environmental planning issues and decide on actions to safeguard public health. (Geiger-FRC)
W82-01606

RAPID, QUANTITATIVE SEPARATION OF CHLOROPHYLLS AND THEIR DEGRADATION PRODUCTS BY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment.
P. G. Falkowski, and J. Sucher.
Journal of Chromatography, Vol 213, No 2, p 349-351, August, 1981. 2 Fig, 11 Ref.

Descriptors: *Water analysis, *Chlorophyll, Measuring instruments, Chromatography, Sediments, Chlorophyll a.

A high-pressure liquid chromatographic system is described for the determination of the major chlorophylls and their degradation products, including chlorophyll a, b, and c, chlorophyllide a, phaeophorbide a, and phaeophytins a and b. For extraction of field samples, 100 to 200 ml sea water were filtered on 25 mm glass-fiber filters. The filters were ground in a tissue grinder with 2 ml of absolute methanol and brie filtered through a glass-fiber filter into a graduated centrifuge tube. The ground glass filters were reextracted on the filter manifold with an additional 1 ml of methanol. A 25-microliter volume of pooled pigment extracts was applied to the HPLC column for analysis. A two-step solvent program was used to resolve chlorophyll c from chlorophyllide a and phaeophorbide a and at the same time allow phaeophytin a to elute in a reasonable time. Methanol-water (90:10) was applied until phaeophorbide a was eluted, followed by methanol-water (98:2). Solvent delivery was automatically programmed with a single-step solenoid valve. The major chlorophylls and the degradation products were separated in 18 minutes. Less than 0.1 pmole of chlorophyll a can be detected by this procedure. This method should serve as a supplement to the simple fluorometric method. For general water analysis, the simple fluorometric method is rapid and precise. For some applications, however, significant artifacts prevent its use alone, for example in the analysis of sediment samples rich in humic and other organic acids. (Baker-FRC)
W82-01619

A SELECTIVE MEDIUM FOR THE ENUMERATION OF STREPTOCOCCUS BOVIS BY MEMBRANE FILTRATION,
Leeds Univ. (England). Dept. of Civil Engineering.
J. I. Oragui, and D. D. Mara.
Journal of Applied Bacteriology, Vol 51, No 1, p 85-93, August, 1981. 4 Tab, 33 Ref.

Descriptors: *Culture media, *Bioindicators, *Streptococcus bovis, *Animal wastes, *Pollutant identification, Microbiological studies, Membrane filters, Agar, Ammonium sulfate, Indicators, Farm wastes, Sewage bacteria, Bacteria, Water analysis.

A new selective medium for the determination and enumeration of Streptococcus bovis was developed for bacterial examination of water and sewage samples. This organism is the predominant fecal streptococcus in farm animals and is relatively rare in humans. Thus it can serve as an indicator of pollution from animal wastes. The membrane-bovis agar medium uses the ability of S. bovis to use ammonium sulfate as its sole nitrogen source as an identifying characteristic. In this medium other common water, sewage, and fecal bacteria are completely inhibited, except for one streptococcus strain associated with pigs. Of 541 colonies isolated from feces, sewage, and stream water, 97% were S. bovis. (Cassar-FRC)
W82-01620

MATACIL RESIDUE DETERMINATION IN FOLIAGE, FISH, SOIL AND WATER,
Mobay Chemical Corp., Kansas City, MO. Div. of Agricultural Chemicals.
C. W. Stanley, and L. M. Delphia.
Journal of Agricultural and Food Chemistry, Vol 29, No 5, p 1038-1039, September-October, 1981. 2 Tab, 5 Ref.

Descriptors: *Matacil, *Pesticide residues, *Gas chromatography, Water analysis, Soil analysis, Insecticides, Separation techniques, Pesticides, Pollutants, Fish, Leaves, Forest soils, Forests, Litter, *Pollutant identification.

A technique is described for detecting the insecticide, Matacil, in foliage, fish, soil, and water without the use of a moisture-sensitive reagent for derivatization. After extraction into 1,2-dichloroethane-methanol, the Matacil was cleaned up by partitioning between organic and aqueous solutions. The sample was derivatized with 1-fluoro-2,4-dinitrobenzene and detected by gas chromatography. Recoveries of the insecticide from fish, foliage and soil fortified with 0.05 ppm Matacil and from water fortified with 0.01 and 0.005 ppm Matacil ranged from 68 to 127%. The lower limit of detection was below 0.001 ppm for water and below 0.01 ppm for fish, foliage and soil. When the present technique is used, the temperature at which the derivatization of Matacil is carried out is not critical, and the resultant derivative is stable. (Geiger-FRC)
W82-01621

SURVIVAL OF ENTEROVIRUSES ADSORBED ON GLASS MICROFIBERS DURING POSTAL TRANSPORT (SURVIE DE VIRUS ENTERIQUES ADSORBES SUR MICROFIBRE DE VERRE AU COURS D'UN TRANSPORT POSTAL),
Nancy-I Univ. (France). Lab. d'Hygiene et de Recherche de la Sante Publique.
J. C. Joret, and J. C. Block.
Canadian Journal of Microbiology, Vol 27, No 2, p 246-248, February, 1981. 2 Tab, 8 Ref.

Descriptors: *Viruses, *Sample preservation, *Water analysis, *Wastewater analysis, Pollutant

identification, *Enteroviruses, Sewage viruses, Poliovirus.

The survival of two enteroviruses was determined after adsorption on glass microfiber filters, 8 micrometers x 60 mm length. Recovery rates for poliovirus type 1, Mahoney strain, were 65 + or - 20% upon immediate elution from the filters and 40 + or - 7% after postal transport at ambient temperatures. Indigenous wastewater viruses showed 100% recovery upon immediate elution, 59% after postal transport at ambient temperatures, and 65% after postal transport at freezing temperatures. Recovery rates were considered satisfactory enough to justify postal shipment of samples for qualitative determination of enteroviruses in water. (Cassar-FRC)
W82-01637

CHARACTERIZATION OF AN ENZYMATIC DETERMINATION OF ARSENIC(V) BASED ON RESPONSE SURFACE METHODOLOGY,
South Carolina Univ., Columbia. Dept. of Chemistry.
R. J. Matthews, S. R. Goode, and S. L. Morgan.
Analytica Chimica Acta, Vol 133, No 2, p 169-182, May 1, 1981. 9 Fig, 4 Tab, 29 Ref. OWRT-B-121-SC(1).

Descriptors: *Arsenic, *Water analysis, Chemical analysis, Enzymes, Pollutant identification.

The use of response surface methodology in developing a method for the enzymatic analysis of arsenic in water is described. A Box-Behnken three-level fractional factorial experimental design was used to characterize the reaction-rate response surface as a function of five experimental factors. Interpretation of the results of regression analysis provides an operational description of the analytical method as well as information that can be correlated with the mechanism of the chemical reaction. The initial simplex optimization produced improved reaction rate response and located a region of near-stationary response. This region, in which further response surface experiments were performed, has been shown to be fairly insensitive to changes in the experimental factors. The characterization of the reaction rate response in this region has facilitated an understanding of the factor effects and interactions that can be correlated with fundamental chemical knowledge to produce an analysis resistant to the effects of uncontrolled changes in experimental factors. (Baker-FRC)
W82-01656

SEDIMENT BACTERIAL INDICATORS IN AN URBAN SHELLFISHING SUBSTUARY OF THE LOWER CHESAPEAKE BAY,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
C. W. Erkenbrecher, Jr.
Applied and Environmental Microbiology, Vol 42, No 3, p 484-492, September, 1981. 6 Fig, 2 Tab, 41 Ref. OWRT-A-080-VA(2).

Descriptors: *Bacteria, *Sediments, *Estuaries, Water pollution effects, Shellfish, Coliforms, Feces, Public health, *Chesapeake Bay, Bacterial analysis, Path of pollutants.

The spatial and temporal distributions and compositions of bacteria in sediments and overlying waters in an urban shellfishing area of the lower Chesapeake Bay region, the Lynnhaven Estuary, were determined. Samples were collected in triplicate at least bimonthly from 11 sites. Bacterial analyses and physiochemical analyses were performed on water and sediment samples. The data showed marked fluctuations in the physiocochemical parameters and the indicator bacteria (total and fecal coliforms and fecal streptococci). The inlet site, which had higher water salinity and coarser sediment, had lower overall bacterial desnities than did the headwater sites. Sediment bacterial counts were higher than bacterial counts of the overlying waters. The counts were above the safe limits for shellfish-growing waters and indicated that the system was fecally polluted. Urban and agricultural runoff were the primary sources of pollution, although failed septic tank systems were also thought to contribute to the problem. Thus, sediments seemed to be a reservoir for high densities of indicator bacteria and could pose a health problem. (Small-FRC)
W82-01661

APPLICATIONS OF STRIPPING ANALYSIS TO METAL DETERMINATIONS IN NATURAL WATERS,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
For primary bibliographic entry see Field 1A.
W82-01670

GEOGRAPHIC VARIATIONS IN WATER QUALITY AND RECREATIONAL USE ALONG THE UPPER WALLOWA RIVER AND SELECTED TRIBUTARIES,
Oregon State Univ., Corvallis. Dept. of Geography.
T. R. McDowell.
PhD Thesis, 1980. 235 p, 37 Fig, 19 Tab, 93 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-13668.

Descriptors: *Water quality, *Baseline studies, *Spatial distribution, *Oregon, Rivers, Water pollution, Recreation, Bacteria, Freshwater, Wallowa River basin, Fecal matter.

This study was designed to examine geographic variations in water quality and recreational use along the upper Wallowa River and selected tributaries in the Wallawa Mountains, an area of concentrated and dispersed wilderness recreation. Analysis conducted during the baseline study revealed that waters in the area drained by the upper Wallowa River were physically and chemically quite pure; however, there were notable temporal and spatial variations in the physical and chemical characteristics of the area's streams. It was concluded that waters upstream from Wallowa Lake are generally nutrient-poor. Nutrient concentrations vary seasonally with hydrological conditions and biological activity, and geographically with differences in watershed lithology. Bacterial water quality based on fecal coliform counts varies significantly between sites and with geographical patterns of recreational use. Bacterial water quality also varies significantly with background environmental conditions (habitats). Bacterial water quality is closely correlated with precipitation events in the middle and lower portions of the study area, but not in the headwaters where sources of fecal contamination are relatively absent. Levels of fecal coliform bacteria in streams outside the alpine zone frequently exceed acceptable limits established for total coliforms in public drinking water; however, no standards exist for unprotected water sources. (Sinha-OEIS)
W82-01681

RANDOM DIFFERENTIAL EQUATIONS IN WATER QUALITY MODELING,
Utah State Univ., Logan.
For primary bibliographic entry see Field 6A.
W82-01688

REVERSE PHASE CONCENTRATION OF TRACE POLYCYCLIC AROMATIC HYDROCARBONS IN WATER,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
D. G. Marsh.
PhD Dissertation, 1980. 182 p, 48 Fig, 33 Tab, 117 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-10468.

Descriptors: *Chemical analysis, *Aromatic compounds, *Water pollution, Pollutant identification, Oil pollution, Chromatography, Polycyclic aromatic hydrocarbons(PAHs), Trace levels.

The determination of polycyclic aromatic hydrocarbons (PAHs) has been accomplished in a wide variety of matrixes. The analysis of water samples for trace levels of PAHs has typically been accomplished by cumbersome multiple extraction techniques. An examination of the phenomenon of trace concentration of PAHs was chosen as the experimental emphasis. The retention behavior of the PAHs, their fluorescence spectra, and a fluorescence normalization procedure are presented. The use of spectrofluorometry to separate chromatographically unresolved peaks was examined. Frontal and elution chromatography were compared, and the elution technique was used to predict frontal retention behavior of PAHs in pure water. The relation between mobile phase strength and reverse phase PAH elution retention at low organic mobile phase concentration was examined. The retention characteristics of concentrator columns were predicted based on correlations to known liquid chromatography approaches. The effects of a variety of concentrator columns on the concentrate analysis was examined. Concentrator column packing, type and concentrator column inner diameter were varied and optimum conclusions were obtained. The optimum system was selected and used to analyze highly polluted Virginia Tech Duck Pond water which was spiked with PAHs at the ppt level. (Sinha-OEIS)
W82-01689

TOXIC SUBSTANCES IN WATER: PATTERNS OF CONTAMINATION AND POLICY IMPLICATIONS,
Rutgers - the State Univ., New Brunswick, NJ.
G. W. Page, III.
PhD Thesis, 1980. 294 p, 8 Fig, 31 Tab, 138 Ref, 5 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-22576.

Descriptors: *Water pollution, *Groundwater, *Surface waters, *Toxicity, Public health, *New Jersey, Surface-groundwater relations, Comparison studies, Case studies, Public policy.

Public policy designed to protect public health from the dangers of water supplies contaminated with toxic substances is discussed with particular attention to policy which treats ground water less stringently than surface water in monitoring and treating water for toxic substances. The central research question addressed in this dissertation is how the contamination of ground water with toxic substances compares to the contamination of surface water with toxic substances in New Jersey. The data used include 692 ground water samples and 320 surface water samples collected throughout New Jersey. The method of determining the relative contamination of ground water and surface water by toxic substances is a set of three analyses. These analyses are repeated for several subsets of the data. The results are remarkably consistent for each of the three analyses for every subset of the data. A comparison of the patterns of toxic substances contamination identified by factor analysis in the ground water and the surface water data sets reveals that these patterns of contamination are very highly correlated between the two data sets. Case studies of two municipalities in Middlesex County, New Jersey are presented. The experiences of these two municipalities are compared and contrasted and used to examine the policy implications of toxic substances contamination of water supplies. (Sinha-OEIS)
W82-01695

HEALTH ASPECTS OF ORGANIC SUBSTANCES IN SOUTH AFRICAN WATERS - OPINIONS AND REALITIES,
National Inst. for Water Research, Pretoria (South Africa).
J. F. J. Van Rensburg.
Water SA, Vol 7, No 3, p 139-149, July, 1981. 3 Fig, 7 tab, 22 Ref.

Descriptors: *Drinking water, *Organic compounds, *Carcinogens, Public health, Water quality standards, Water analysis, Water quality management, *Literature review, *South Africa.

A literature review is presented of available information on the determination of permissible concentrations of organic micro-pollutants in potable water in an attempt to propose guidelines for South African water quality standards. Progress in the United States and Europe is summarized. A

relatively inexpensive and simple method of expressing and evaluating the possible health hazard of organic pollution is the OPI (organic pollution index) and related analytical methods. Water supplies exceeding OPI limits could be referred to sophisticated laboratories for detailed analysis. The water supplies that have been investigated in South Africa have not presented a health hazard due to volatile organic micropollutants except for a few locations including the Vaal River below the Barrage. More advanced analytical techniques are needed for non-volatile organic matter in water. When tests indicate the presence of mutagens in potable water, more sophisticated investigations, in this case chemical techniques, should be performed. (Small-FRC)
W82-01712

DISTRIBUTION OF VIBRIO PARAHAEMOLYTICUS IN FINFISH HARVESTED FROM PORTO NOVO (S. INDIA) ENVIRONS: A SEASONAL STUDY,
Center of Advanced Study in Marine Biology, Porto Novo (India).
G. B. Nair, M. Abraham, and R. Natarajan.
Canadian Journal of Microbiology, Vol 26, No 11, p 1264-1269, 1980. 3 Fig, 3 Tab, 31 Ref.

Descriptors: *Vibrio parahaemolyticus, *Bacteria, *Fish, Fate of pollutants, Pollutant identification, Pathogens, Porto Novo, *India, Bay of Bengal.

The pathogenic bacterium, Vibrio parahaemolyticus, was isolated from fish samples collected at five locales in the Porto Novo, India, region as follows: estuary, 35.6%; mangroves, 40.6%; Bay of Bengal, 3.9%; landing site, 46.8%; and fish market, 40.6%; average of all locales, 36.8%. Highest levels of bacteria were found in July and August in the mangroves and in April in the other locales. Mullets had the highest isolation rates, 56.3%. Fish become contaminated at the market through sprinkling with estuarine water and lack of refrigeration. (Cassar-FRC)
W82-01737

ORGANIC SUBSTANCES IN WATER,
Geological Survey, Reston, VA. Water Resources Div.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-C, 1981. 19 p, 3 Fig, 2 Tab, 13 Ref. (Edited by Greeson, P. E.).

Descriptors: *Water quality, *Organic compounds, *Environmental effects. *Pollutant identification, Taste, Odors, Classification, Solutes, Natural waters.

This is the third of several compilations of briefing papers on water quality by the U.S. Geological Survey. Each briefing paper is prepared in a simple, nontechnical, easy-to-understand manner. This U.S. Geological Survey Circular contains papers on selected organic substances in water. Briefing papers are included on 'Why study organic substances in water.', 'Taste and odor in water', and 'Classification and fractionation of organic solutes in natural waters'. (USGS)
W82-01783

INFECTIOUS WATERBORNE DISEASES,
Geological Survey, Reston, VA. Water Resources Div.
P. E. Greeson.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-D, 1981. 16 p, 8 Fig, 2 Tab, 90 Ref.

Descriptors: *Water quality, *Water pollution effects, *Pollutant identification, *Infection, *Diseases, Bacteria, Viruses, Parasites, Contamination, Drinking water, Waterborne diseases.

This is the fourth in a series of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, nontechnical, easy-to-understand manner. This U.S. Geological Survey Circular contains a paper on; Infectious waterborne diseases', which discusses 36 infectious diseases of man than can be or are strongly suspected of being transmitted by water. Of the 36 diseases, 12 are caused by bacteria, 4 are caused by viruses, 19 are caused by parasites, and 1 has numerous infectious agents. (USGS)
W82-01784

MICROBIOLOGY OF THE AQUATIC ENVIRONMENT,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5C.
W82-01786

COMPARISON OF LIQUID-LIQUID EXTRACTION AND RESIN ADSORPTION FOR CONCENTRATING MUTAGENS IN AMES SALMONELLA/MICROSOME ASSAYS ON WATER,
National Inst. for Water Research, Pretoria (South Africa).
W. O. K. Grabow, J. S. Burger, and C. A. Hilner.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 442-449, October, 1981. 4 Tab, 14 Ref.

Descriptors: *Salmonella, *Bioassay, *Mutagens, Microorganisms, Contaminants, Potable water, Wastewater, Rivers, Vaal River, Drinking water, *South Africa.

Mutagen recovery from different waters was compared using dichloromethane (DCM) liquid-liquid extraction and adsorption on Amberlite XAD resins, techniques often employed for recovery of mutagens from water. Grab samples were collected from the final product of a multiple-barrier wastewater reclamation plant, from laboratory tap water representing a potable water supply prepared mainly from surface water, and from the Vaal River at points about 50 meters below the barrage, 20 meters below the influent of a wastewater effluent from Sasolburg, and 1 kilometer below the inflow point of a wastewater effluent from Vanderbijlpark. The mutagenicity ratio (MR) values for concentrates of the four Vaal River samples showed that DCM extraction yielded the highest mutagenic activity for two samples, and XAD-2 adsorption for one. DCM extracts had the highest mutagenic activity for two samples, and XAD-2 concentrates for three of the ten samples of reclaimed water. DCM extracts had the highest MR value for 11 and XAD-2 concentrates for two of the 15 tap water samples. Mutagenic activity was detected in DCM extracts of all 15 tap water samples, while XAD concentrates of two samples failed to show mutagenic activity at all. Dose-response tests were conducted on nine tap water samples. At least 14 of the 18 DCM extracts had higher MR values for dimethyl sulfoxide dilutions than for the original extract. In the case of XAD-2 this was noted for only one of the nine concentrates. Although this study shows that DCM liquid-liquid extraction is superior to XAD adsorption for concentrating mutagens from a variety of waters, it indicates that both methods have their limitations. (Baker-FRC)
W82-01812

GAUZE FILTRATION AND ENRICHMENT PROCEDURES FOR RECOVERY OF VIBRIO CHOLERAE FROM CONTAMINATED WATERS,
John Hopkins Univ., Baltimore, MD. Div. of Geographic Medicine.
W. M. Spira, and Q. S. Ahmed.
Applied and Environmental Microbiology, Vol 42, No 4, p 730-733, October, 1981. 3 Fig, 1 Tab, 8 Ref.

Descriptors: *Filtration, *Vibrio, Bacteria, Public health, Epidemics, Water analysis, Enrichment, Pollutants, Human diseases, Microbiological studies, Monitoring, Surface waters, Drinking water.

Gauze filtration was tested as a simple, inexpensive technique for sampling of nonflowing surface waters. The procedure proved more effective in recovering Vibrio cholerae 0:1 than culturing 1 liter water samples and required about the same amount of effort. The most effective combination of enrichment and plating media for isolating V. cholerae from contaminated surface waters is presented. The perfect performance of 18 hr alkaline bile-peptone water (ABPW) enrichment of filtration samples in the study plus the demonstrated superiority of filtration over water grab sampling in 6 hr enrichment cultures suggests that a larger scale evaluation would better demonstrate the significance of this method. The ability of 18 hr ABPW enrichment cultures of filtration samples was then evaluated to isolate laboratory grown V. cholerae biotype eltor from pond water into which it was added in graded concentrations. The procedure was able to detect V. cholerae at concentrations as low as 10 organisms per liter of natural pond water. Thus the method appears accurate and inexpensive for conducting large scale surveillance of water sources for contamination by V. cholerae biotype eltor, the organism which is responsible for the current cholera pandemic in Bangladesh. (Baker-FRC)
W82-01815

DETERMINATION OF HEXACHLOROCYCLOPENTADIENE AT THE NANOGRAM PER LITER LEVEL IN DRINKING WATER,
Health and Welfare Canada, Ottawa (Ontario).
F. M. Benoit, and D. T. Williams.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 3, p 303-308, September, 1981. 1 Fig, 3 Tab, 8 Ref.

Descriptors: *Potable water, *Pollutant identification, *Water sampling, Resins, Solvents, *Hexachlorocyclopentadiene, Water analysis, Chemical analysis, Organic compounds.

A solvent extraction method is described for the determination of hexachlorocyclopentadiene (HCCP) in drinking water. The possibility that HCCP is light sensitive was investigated by storing half of a solution of HCCP at known concentration in the dark and the other half in a clear glass container in the light for a period of nine days. A steady decrease in HCCP concentration in the exposed solution was noted. It was concluded, therefore, that HCCP is light sensitive in both organic and aqueous solutions, and that the rate of decay is dependent on the intensity of the incident radiation. Next the efficiency of XAD-2 resin to extract HCCP from water was estimated by passing tap water through two cartridges containing XAD-2 resin connected in series such that the effluent from the first was passed through the second. It was concluded that the extraction of HCCP from water with XAD-2 macroreticular resin cannot be used to quantify accurately the level of HCCP in drinking water, but may be used to screen water samples qualitatively. In cases where the anticipated levels of HCCP in drinking water are high, analysis of low water volumes by solvent extraction is possible. However, the limit of detection by the organic solvent method is about 50 ng/liter, whereas with the XAD-2 method the level of HCCP in raw water which is detectable is about 0.5 ng/liter. (Baker-FRC)
W82-01819

DETERMINATION OF FREE METAL ION CONCENTRATIONS USING BIOASSAYS,
Canada Centre for Inland Waters, Burlington (Ontario); and National Oceanic and Atmospheric Administration, Ann Arbor. Great Lakes Environmental Lab.
U. Borgmann.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 999-1002, August, 1981. 2 Tab, 20 Ref.

Descriptors: *Trace metals, *Cooper, *Bioassay, Pollutant identification, Heavy metals, Toxicity, Metals, Aquatic life, *Copepods, Invertebrates, Chelation, Amino acids.

Trace metal levels were determined by comparing metal toxicity to copepods before and after the addition of weak complexing agents (amino acids) with known stability constants. The growth of

freshwater copepods was affected at free copper concentrations as low as the order of 10 to the minus 10th power. These trace levels are lower than those detected by any other method, including metal ion electrodes. The method is applicable to natural waters or artificial media and the decrease in growth rates or any other quantifiable response used as a measure of free metal concentration. (Cassar-FRC)
W82-01821

SIMULTANEOUS DETERMINATION OF TRACE METALS IN SEWAGE AND SEWAGE EFFLUENTS BY INDUCTIVELY COUPLED ARGON PLASMA ATOMIC EMISSION SPECTROMETRY,
Ontario Ministry of the Environment, Rexdale (Ontario). Lab. Services Branch.
M. M. Moselhy, and P. N. Vijan.
Analytica Chimica Acta, Vol 130, No 1, p 157-166, 1981. 2 Fig, 3 Tab, 13 Ref.

Descriptors: *Metals, *Wastewater analysis, *Emission spectroscopy, *Trace metals, Heavy metals, Pollutant identification, Spectroscopy, Atomic absorption spectroscopy.

Inductively coupled plasma emission spectroscopy (I.C.P.) was adapted for simultaneous determination of several trace metals in sewage and sewage effluents. Aqua regia was chosen as the reagent for sample digestion after comparisons with sulfuric-nitric and prechloricnitric acid mixtures. Correlation coefficients between the i.c.p. and atomic absorption methods were 0.979-0.999 for Cr, Pb, Fe, Ni, Cu, Zn, and Cd. Other metals determined were: Al, Ca, Co, Mg, Mn, Mo, Sr, Ti, and V. (Cassar-FRC)
W82-01828

NITRATES, CHLORATES AND TRIHALOMETHANES IN SWIMMING POOL WATER,
Florida International University, Miami. Drinking Water Quality Research Center.
J. A. Beech, R. Diaz, C. Ordaz, and B. Palomeque.
American Journal of Public Health, Vol 70, No 1, p 79-82, January, 1980. 2 Fig, 3 Tab, 18 Ref.

Descriptors: *Swimming pools, *Nitrates, *Chlorates, *Trihalomethanes, Public health, Swimming, Water quality, Human pathology, Metabolism, *Miami, Florida.

Water of selected swimming pools in the Miami area was analyzed for contaminants that might present a hazard to users, including nitrates, chlorates, and trihalomethanes. The average concentration of nitrates was 8.6 mg/liter, and of chlorates was 16 mg/liter. The average concentration of trihalomethanes in beach-front saline pools was 657 micrograms/liter, and in freshwater pools was 125 micrograms/liter. The maximum concentration of nitrate was 54.8 mg/liter, of chlorate 124 mg/liter, and of trihalomethanes 439 micrograms/liter (freshwater) and 1287 micrograms/liter (salt water). While adults can consume considerable amounts of nitrate and chlorate without ill effects, the effects of these chemicals on young infants are not clear. Because of the popularity of infant swimming class, and because of the possibility of infants and young children ingesting large amounts of water during swimming, the effects of these levels of contaminants must be studied further. The adsorption of trihalomethanes through the skin also needs study. (Small-FRC)
W82-01835

DETERMINATION OF GERMANIUM, VANADIUM, AND TITANIUM BY CARBON FURNACE ATOMIC ABSORPTION SPECTROMETRY,
Polish Academy of Science, Zabrze. Inst. of Environmental Engineering.
M. Studnicki.
Analytical Chemistry, Vol 52, No 11, p 1762-1764, September, 1980. 3 Tab, 39 Ref.

Descriptors: *Atomic absorption spectroscopy, *Germanium, *Vanadium, *Titanium, Water analysis, Chemical interference, Metals.

The determination of germanium, vanadium, and titanium by carbon furnace atomic adsorption spectrometry was investigated, with emphasis on interferences which may lead to an increase or decrease in the absorption signal. Acids were found to strongly influence the signal for all three elements. Nitric acid increased the signal of germanium, but decreased the signals of vanadium and titanium. Sulfuric acid decreased the signal of all examined elements. Phosphoric acid increased the signal of vanadium and titanium, but decreased the signal of germanium. Hydrochloric acid increased the signal of titanium and decreased the signals of vanadium and germanium. On the whole, the ammonium salts of these acids had similar effects. For all examined elements, the working range was 0.1 to 0.5 ppm, and calibration graphs were linear up to a concentration of approximately 0.4 ppm. Sensitivities were: 0.015 ppm for germanium 0.03 ppm for vanadium, and 0.09 ppm for titanium. (Small-FRC)
W82-01836

A GEL PARTITION MODEL FOR ORGANIC DESORPTION FROM A POND SEDIMENT,
Maryland Univ., College Park. Dept. of Chemistry.
D. H. Freeman, and L. S. Cheung.
Science, Vol 214, No 3422, p 790-792, November 13, 1981. 3 Fig, 24 Ref.

Descriptors: *Sediments, *Organic carbon, *Ponds, Adsoprtion, *Model studies, Gels, Chemical analysis.

A sediment model is described which expresses the natural affinity of nonpolar compounds for the relatively nonpolar polymeric component, called humin or kerogen, that is present in most sediments. Physical considerations were used to derive criteria that minimize this affinity and maximize the ease of extraction. An experiment was performed on the liquid extraction of a lipophilic compound in a simplified situation where the compound was known to be present in high concentration in an industrial pond sediment. Several experiments were conducted to attempt to distinguish between equilibrium and nonequilibrium desorption from sediment. In general, agreement was noted between the gel partition model and the hypothesized behavior of the humin-kerogen structure in sediment samples during extraction of the lipophilic solute DEHP. The model correctly predicted near-optimal extraction by dichloromethane and predicted conditions for gel concentration that were consistent with the finding of slow secondary diffusion in a nonoptimal liquid. These results indicate that partitioning or adsorption effects alone would tend to be irreversible unless the equilibrium condition is clearly demonstrated experimentally. In aqueous systems equilibrium may be particularly difficult to obtain. In attempting to desorb lipiphilic substances from sediment samples that are finely divided, it is clear that the humin-kerogen pore structure needs to be kept open by use of proper extractive conditions, including use of a suitable swelling-dissolving liquid that provides adequate diffusion rates. (Baker-FRC)
W82-01844

LOADING ESTIMATES TO LAKE ERIE, 1967-1976,
National Water Research Inst., Burlington (Ontario).
A. S. Fraser, and K. E. Willson.
Scientific Series No 120, 1981. 23 p, 10 Fig, 1 Tab, 16 Ref, 2 Append.

Descriptors: *Wastes, Discharges, *Atmospheric loading, Phosphorous, Nitrogen, Nitrate, Ammonia, Mathematical models, Great Lakes, *Lake Erie, Nutrients, Total load, *Effluents, Water pollution sources.

This report presents the author's best estimate of the loading for several chemical variables to Lake Erie. Every effort has been made to obtain original raw data as accepted by local agencies so that a truly independent assessment of loadings could be made. The raw data, once obtained, were treated uniformly to eliminate the difficulties that arise from the comparison of loads calculated by various techniques. However, because of the limitations of sampling a highly variable natural system in the environment, the results included in this study must be called estimates and hence may be subject to unknown or unaccountable errors, which make placement of confidence limits difficult. Nevertheless, the following document is presented with the belief that the results represent the most comprehensive, independent study of loadings to Lake Erie presently available. (WATDOC)
W82-01852

VARIATIONS AND MECHANISMS OF ASBESTOS FIBRE DISTRIBUTION IN STREAM WATER,
National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
H. Schreier, and J. Taylor.
Technical Bulletin, No 118, 1981. 17 p, 21 Fig, 3 Tab, 51 Ref.

Descriptors: *Minerals, *Asbestos, Concentrations, *Streams, *Basins, Surveys, Natural sources, Sources, Distribution, *Sumas River Basin, British Columbia, Washington State, Variations, Spatial, Distribution, Temporal distribution.

Asbestos fiber concentrations were determined in a ten-month study on the Sumas River in British Columbia and Washington State. Regional background levels were found to be somewhat lower than the water affected by the slide, but nevertheless the values were high, reaching concentrations of up to 10 sup 10 fibres/litre. Six stations were sampled during the major hydrologic events of the 1979-1980 season, and all showed seasonal fluctuations in asbestos concentration, some as high as four orders of magnitude. In addition, great differences in concentrations were also found between stations (10 sup 8 -10 sup 13 fibers/litre). This suggests that occasionally collected grab samples provide an insufficient data base for asbestos analysis of stream water. A laboratory settling experiment, which used stream bed sediments, was carried out to study the mechanism of transport of fibers. Evidence was produced to suggest that suspended asbestos fibers settle to the bottom in the absence of turbulence and water movement. The rate of settling decreases with time, and smaller fibers appear to remain in suspension longer than larger fibers. Some limited evidence of this process was also found in one stream station where the highest asbestos concentrations and the largest concentrations and smallest range in fiber size, during minimum streamflow. Unfortunately, this process could not be identified consistently, and particle interferences during the settling process are thought to be the cause of the more complex settling pattern of asbestos fibers. (WATDOC)
W82-01853

INTERLABORATORY QUALITY CONTROL STUDY NO. 26, ARSENIC AND SELENIUM IN WATER,
National Water Research Inst., Burlington (Ontario). Water Quality Branch.
V. Cham, and K. I. Aspila.
Report Series No 68, 1980, 12 p, 6 Fig, 6 Tab, 19 Ref, Append.

Descriptors: *Arsenic, *Silenium, *Water analysis, *Toxicity, Carcinogens, Elements, Concentrations, Data collections, Detection limits, Atomic absorption spectrometry, Pollutant identification.

An intercomparison study on the determination of arsenic and selenium in water is described. Thirty Canadian laboratories participated, and each analyzed 10 natural, spiked and distilled water samples preserved with 0.2% H2S04 in polyethylene containers. The concentration of both elements ranged from 0 to 1000 microg/L. Pooled analytical data were assessed using several statistical analyses-which included outlying tests, paired sample treatments, and ranking technique-to determine laboratory performance and bias. The majority of participants using the atomic absorption technique via atomization of hydrides produced reliable results. Based on the data from this study, this technique was assessed to be preferable to colorimetry,

atomic emission and atomic absorption using graphite atomizer because of its good sensitivity and its capability of analyzing the whole concentration range. (WATDOC)
W82-01854

STANDARD PROCEDURE FOR TESTING THE ACUTE LETHALITY OF LIQUID EFFLUENTS.
Environmental Protection Service, Ottawa (Ontario). Water Pollution Control Directorate.
Report No EPS 1-WP-80-1, 1980, 11 p. 4 Ref, Append.

Descriptors: *Acute toxicity, *Effluents, *Rainbow trout(Salmo gairdneri), *Bioassay, Standard methods, Lethal limit, Toxicity, Trout.

This procedure represents a simpler alternative to the test for acute toxicity described in regulations and guidelines already published by the federal government. While it has not been designed for scientific research, this procedure has been developed in the course of a number of years of laboratory experience, as well as through extensive review of available literature and consultation with a number of scientists. It has been demonstrated to be a valid test for lethality of an effluent, and allows a large number of tests to be performed under a variety of circumstances. Other tests may be developed in the future to accommodate changes in bioassay methods and best practicable wastewater treatment technology. The intent of this test is to provide sufficient standardization so that the various effluents now subject to federal regulations and guidelines can be dealt with as equitably as possible. Further information regarding techniques and equipment may be obtained from the Environmental Protection Service (EPS) Laboratories listed in the Appendix. (WATDOC)
W82-01905

NUMERICAL TAXONOMY ANALYSIS OF BACTERIA ISOLATED FROM THE COMPLETED 'MOST PROBABLE NUMBERS' TEST FOR COLIFORM BACILLI,
Maryland Univ., College Park. Dept. of Microbiology.
B. Austin, D. Hussong, R. M. Weiner, and R. R. Colwell.
Journal of Applied Bacteriology, Vol 51, No 1, p 101-112, August, 1981. 2 Fig, 4 Tab, 42 Ref.

Descriptors: *Most Probable Number test, *Coliforms, *Bacteria, *Taxonomy, Pollutant identification, Enterobacter, Lactobacillus, Water analysis, Microbiological studies.

Lactose-fermenting bacteria isolated from water, estuarine sediment, and oyster samples from Chesapeake Bay were identified and compared with results of the widely-used Most Probable Number (MPN) test for coliforms. In all, 13 phena were found. Escherichia coli, Citrobacter freundii, Klebsiella pneumoniae, Serratia liquefaciens, Serratia marcescens, Erwina herbicola, Hafnia alvei, Acinebacter calcoaceticus, and Chromobacterium violaceum were positively identified. Two phena strongly resembled Pseudomonas aeruginosa and P. fluorescens. Two phena, which did not appear to be Enterobacteriaceae, could not be identified. The large number of non-enterobacter isolates suggests that the MPN method may not be reliable for assessing the sanitary quality of water samples. Some strains of E. coli, E. herbicola, H. alvei, and non-enterobacters appeared to lose their ability to ferment lactose upon storage on laboratory media at room temperature for 8 weeks. (Cassar-FRC)
W82-01911

VARIATIONS IN TRACE METAL CONTENT OF THE MUSSEL CHOROMYTILUS MERIDIONALIS (KR.) WITH SEASON AND SEX,
National Research Inst. for Oceanography, Stellenbosch (South Africa).
M. J. Orren, G. A. Eagle, H. F-K. O. Hennig, and A. Green.
Marine Pollution Bulletin, Vol 11, No 9, p 253-257, September, 1980. 4 Tab, 21 Ref.

Descriptors: *Mussels, *Bioindicators, *Trace metals, Monitoring, Sampling, Biological samples, Iron, Copper, Lead, Cadmium, Manganese, Zinc, South Africa.

Trace metal contents of whole bodies of mussels were determined on C. meridionalis collected in June and November from intertidal pools at Bloubergstrand, near Cape Town, South Africa. The mussels in the area had fairly low concentrations of trace metals when compared to those from other areas, but were similar to results obtained for C. meridionalis and Perna perna by other workers at unpolluted sites in the vicinity. In males, copper, iron, lead, zinc, and manganese increased significantly from June to November. In females, iron, lead, cadmium, copper, and zinc increased significantly. This seasonal variation may be due to phytoplankton productivity and the availability of food, or to the effect of temperature on the rate of excretion. Because of the differences found in sexes, for monitoring purposes, only sexually immature animals should be used. Rigid standardization of mussel sampling procedures for use as water quality indicators is needed. (Small-FRC)
W82-01969

WATER QUALITY INDICES: AN ADDITIONAL MANAGEMENT TOOL,
Middlesex Polytechnic, London (England).
For primary bibliographic entry see Field 5G.
W82-01994

ION FLOTATION-SPECTROPHOTOMETRIC DETERMINATION OF TRACES OF CHROMIUM (VI),
Tokyo Metropolitan Univ (Japan). Dept. of Industrial Chemistry.
M. Aoyama, T. Hobo, and S. Suzuki.
Analytica Chimica Acta, Vol 129, p 237-241, August, 1981. 2 Fig, 1 Tab, 5 Ref.

Descriptors: *Metals, *Water pollution control, Natural waters, *Pollutant identification, Pollutants, *Chromium, Monitoring, Industrial wastes, Chemical analysis, Water analysis, Spectrophotometry, Flotation, Separation techniques.

The usefulness of diphenylcarbazide (DPCI) as a selective collector for chromium has been investigated. Optimum conditions are described for the flotation of chromium(VI) in batch and continous experiments. The proposed method is rapid and applicable to the determination of chromium(VI) at microgram/liter levels. For batch flotation enough sulfuric acid was added to a 1 liter sample containing 3-70 micrograms of chromium(VI) to make the acidity 0.1 M. After adding 5 ml of 1% DPCI solution and shaking for 5 min, the solution was transferred to the separation tube. Nitrogen was passed at a flow rate of 105 ml/min into the tube and 1% sodium lauryl sulfate (SLS) solution was pumped into the tube at a flow rate of 0.54 ml/min. The foam coming out of the separation tube was collected for 20 min in the foam collector which contained 0.5 ml of n-butanol. The subsided foam solution was transferred to a 50-ml volumetric flask and diluted to the mark with water. Absorbance was measured at 540 mm, using water as reference. The procedure for continuous flotation is also described. During batch flotation studies the effects of diverse ions on the flotation of Cr(VI) were investigated, and it was determined that only a few ions interfered. Even so, Cr(VI) in the sample is measured. If this system were connected with a continous photometric detector, a good pollution monitoring system would be realized. (Baker-FRC)
W82-02007

ON SITE CONTINUOUS LIQUID-LIQUID EXTRACTION OF NONPOLAR ORGANIC COMPOUNDS IN WATER,
Bremen Univ. (Germany, F.R.). Dept. of Chemistry.
B. Stachel, K. Baetjer, M. Cetinkaya, J. Dueszeln, and U. Lahl.
Analytical Chemistry, Vol 53, No 9, p 1469-1472, August, 1981. 6 Fig, 4 Tab, 7 Ref.

Descriptors: *Insecticides, *Water analysis, Pollutant identification, *Weser River, *Germany, Pesticides, Lindane, Hexachlorobenzene, Hexachlorocyclohexane, Chlorinated hydrocarbons.

The Ahnoff and Josefsson apparatus for determining pesticides in water by continuous liquid-liquid extraction was modified by installation of an electronically directed water level regulator. Analysis of 500 liter water samples using from the Weser River, Federal Republic of Germany, using this method of concentration and gas chromatography gave the following results: alpha-1,2,3,4,5,6-hexachlorocyclo-hexane (alpha-BHC), 3.3 ng per liter; lindane (gamma-BHC), 11.6 ng per liter; hexachlorobenzene (HCB), 0.4 ng per liter; and beta-BHC, not detected. Detection limits (in ng per liter) were: 0.2, 0.5, 0.2, and 0.7, respectively. Laboratory studies of added pesticides gave the following recoveries: alpha-BHC, 77.0%; lindane, 73.8%; and alpha-BHC plus HCB, 44.7%. (Cassar-FRC)
W82-02008

MEASUREMENT OF HEAVY WATER CONCENTRATION WITH A DENSITY METER,
National Inst. of Radiological Sciences, Chiba (Japan). Div. of Environmental Health.
Y. Inoue, K. Tanaka, and Y. Kasida.
Analyst, Vol 106, No 1263, p 609-619, June, 1981. 8 Fig, 5 Tab, 6 Ref.

Descriptors: *Water analysis, *Deuterium, Measuring instruments, Density, Density meter, Heavy water, Water treatment.

The applicability of a high-sensitivity density meter was investigated for the determination of the deuterium content of water, the determination of the separation factor, alpha, in the electrolytic enrichment process for deuterium, and to remove the drawbacks associated with conventional methods of density measurement. The effects of temperature and solute impurities on the method were investigated and the purification of water by sublimation and anion-exchange techniques were examined as a means of overcoming the latter. The methods, using a high-sensitivity density meter, proved applicable to the accurate determination of levels of deuterium in water samples above 0.1 mol-%. Electrical conductivity or specific resistance proved to be a good measure of the purity of the water to be used for the densitometry. Purification of the water to a specific resistance value was achieved easily using a combination of anion exchange and sublimation procedures. These techniques are relatively simple and rapid in comparison with conventional purification methods and the time required for the purification may be shortened by as much as 5 hr per sample. The simultaneous handling of many samples was easy to achieve. The density meter allowed density measurements to be completed within 10 min. In general, this method was superior to the conventional methods with respect to sample size, measuring time, sensitivity and accuracy. (Baker-FRC)
W82-02009

ON THE PRESENCE OF FECAL STEROIDS IN SEDIMENTS FROM TWO MEXICAN HARBORS,
Universidad Nacional Autonoma de Mexico, Mexico City. Centro de Ciencias del Mar y Limnologia.
R. L. Escalona, M. T. L. Rosales, and E. F. Mandelli.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 2, p 289-295, 1980. 2 Fig, 2 Tab, 13 Ref.

Descriptors: *Aquatic environment, Wastes, *Contamination, *Harbors, Sediments, Feces, Water pollution, Coastal waters, Coasts, Estuaries, Marine sediments, Wastewater, Microorganisms, Bacteria, Bioindicators, *Wastewater, *Mexico.

Samples of sediments from two coastal cities in Mexico were analyzed for coprostanol and cholesterol to determine the degree of sewage pollution in the two areas. Coprostanol concentrations ranged from 0.006 to 0.44 parts per million in the Veracruz harbor. These are relatively low concen-

trations and indicate the absence of direct sewage discharges from the city. Unreported sewage outfalls from shipyards are believed to be the major source of fecal pollution. Concentrations were significantly higher in Mazatlan, ranging from 0.020 to 0.20 parts per million. Mazatlan discharges a high percentage of untreated sewage into the harbor. (Titus-FRC)
W82-02012

AN ANALYSIS OF THE AQUATIC MACROPHYTE, MYRIOPHYLLUM EXALBESCENS, AS AN INDICATOR OF METAL CONTAMINATION OF AQUATIC ECOSYSTEMS NEAR A BASE METAL SMELTER,
Department of Fisheries and Oceans, Winnepeg (Manitoba). Freshwater Inst.
W. G. Franzin, and G. A. McFarlane.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 597-605, 1980. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Aquatic organisms, *Ecosystems, *Contamination, *Trace metals, *Bioindicators, Tissue analysis, Macrophytes, Lakes, Aquatic environments, Physical properties, Chemical properties, Vegetation, Environmental effects, Industrial wastes, Water pollution.

The suitability of Myriophyllum exalbescens as an indicator of metal contamination in aquatic ecosystems was tested. Metal concentrations of samples of the species populations in six lakes with a range of metal contamination in water and sediment were analyzed. Prepared plant samples were analyzed for iron, manganese, lead, copper, cadmium, and zinc by flame atomic absorption spectrophotometry. Comparison of plant metal concentrations with the metal concentrations in lake waters and sediments showed that a fair correspondence existed only for zinc. This result, coupled with observations of year to year variance in plant metal concentrations, suggests that aquatic plants are unreliable indicators. (Titus-FRC)
W82-02016

DETECTION OF ORGANOPHOSPHATE INSECTICIDE BY AN IMMOBILIZED-ENZYME SYSTEM,
Visva-Bharati Univ., Santiniketan (India). Dept. of Zoology.
S. Bhattacharya, C. Alsen, H. Kruse, and P. Valentin.
Environmental Science and Technology, Vol 15, No 11, p 1352-1355, November, 1981. 5 Fig, 2 Tab, 19 Ref.

Descriptors: *Organophosphorus pesticides, *Enzymes, *Insecticides, Pollutant identification, Parathion, Carbaryl, Pesticide residues, Water analysis, Trace levels.

Low levels of organophosphate insecticides were detected in water samples using acetylcholinesterase covalently bound to poly(maleic anhydride) on a Celite 545 column. The second-order rate constant for paraoxon (10 to the minus 7th power M) was within the range of that found in a stirred suspension, but a significant increase in the rate constant was seen at paraoxon concentrations of 10 to the minus 8th to 10th powers M. Reactivation by obidoxime confirmed that the enzyme inhibition effect was caused by an organophosphate. All concentrations of carbaryl-paraoxon mixtures showed a decrease in rate of inhibition on the column. (Cassar-FRC)
W82-02025

EXPERIENCE WITH A SIMPLE METHOD FOR THE BIOLOGICAL EVALUATION OF SURFACE WATER QUALITY,
Rijksinstituut voor Zuivering van Afvalwater, Lelystad (Netherlands).
Th. G. N. Dresscher, and H. van der Mark.
Hydrobiologia, Vol 71, No 1/2, p 169-173, May, 1980. 1 Tab, 19 Ref.

Descriptors: *Bioindicators, *Saprobity, *Water quality, *Pollutant identification, Surface water, Water analysis, Algae, Ciliates, Euglenophyta, Chlorococcales, Diatoms, Peridinium, Chrysophyta, Conjugales.

The simple method for the evaluation of saprobity in surface water, published by the authors in 1974 and 1976, is discussed. It was designed for use by water and sewage treatment laboratories and requires identification of a number of groups rather than species. Organisms in four groups are identified and their presence used in a formula to calculate the saprobic quotient, which ranges from -3 for very severe pollution with many organic substances to +3 for very slight pollution with few organic or inorganic substances. Group A comprises Ciliates (indicators for polysaprobity); Group B, Euglenophyceae (indicators for alpha-mesosaprobity); Group C, Chlorococcales and Diatoms (indicators for beta-mesosaprobity); and Group D, Peridineae, Chrysophyceae, and Conjugales (indicators for oligosaprobity). This method cannot be used satisfactorily when surface water contains a bloom of an organism, during cold weather, and under turbid water conditions. Sampling should be done away from a bank and at a depth of 50 cm. (Cassar-FRC)
W82-02029

TURNOVER OF TRITIATED WATER IN CALAMONDIN PLANTS,
Volcani Inst. of Agricultural Research, Bet-Dagan (Israel).
A. Mantell, E. E. Goldschmidt, and S. P. Monselise.
Journal of the American Society for Horticultural Science, Vol 105, No 5, p 741-744, September, 1980. 1 Fig, 3 Tab, 17 Ref.

Descriptors: *Plant populations, *Water requirements, Absorption, Nutrients, Calamondin plants, Transpiration, *Fruit crops, *Radioactivity, Tritium.

The relative water turnover was investigated in the vegetative and reproductive parts of calamondin plants as affected by different environmental conditions. The plants used were about 3 yr old and 40 cm tall, with fruit at different stages of development. Uptake measurements were made using tritium-labeled nutrient solution. The turnover was much greater in vegetative tissue than in the fruit. Even after three days, the radioactivity of water in the fruit, relative to that in the solution, did not reach 20% compared with about 60% in the leaf tissue. The radioactivity of water in pedicel reached 60%, similar to that in leaf tissue. Decay of radioactivity in fruit was considerably slower than in other organs when the plant was transferred from a labelled to a non-labelled solution. The turnover of water in fruit was extremely slow even when transpiration was increased by exposing the entire plant or the fruit alone to a stream of dry air. Defoliation of fruit-bearing branches decreased the entry of water into fruit tissues. The availability of water for fruit growth in view of the competition offered by the leaves is discussed. (Baker-FRC)
W82-02048

ISOLATION OF THE MYCOBACTERIUM AVIUM-M. INTRACELLULARE-M. SCROFULACEUM COMPLEX FROM TANK WATER IN QUEENSLAND, AUSTRALIA,
Chest Clinic, Brisbane (Australia).
R. E. Tuffley, and J. D. Holbeche.
Applied and Environmental Microbiology, Vol 39, No 1, p 48-53, January, 1980. 1 Fig, 5 Tab, 35 Ref.

Descriptors: *Bacteria, *Water tanks, Human diseases, Fitzroy River, Rivers, Queensland, *Australia, Mycobacterium, Cultivated lands, Agriculture, Cropland, *Rainwater.

The isolation of mycobacteria is reported from 67 of 205 rainwater tanks in three areas of Queensland. M. intracellulare was a comon isolate, and representatives of eight disease-related serotypes were found. Organisms of the MAIS complex and M. gordonae were the most frequent isolates. Rapid growers were found in two tanks near Rockhampton, whereas the M. terrae-M. triviale-M. nonchromogenicum complex was isolated occasionally in the Fitzroy basin. No M. simiae were found. Mycobacteria were recovered from 7 of the 32 tanks sampled repetitively from the city of Toowoomba. All three isolates of M. intracellulare occurred after the heavy summer rainfall in January. M. intracellulare and M. gordonae were the principal isolates recovered from 7 and 9 of the 32 tanks sampled, respectively, in Rockhampton Hinterland. Mycobacteria were isolated from 46 of the 141 tanks sampled in the Fitzroy Basin. The presence of plowed land did not appear to influence the isolation rate of M. intracellulare on rural holdings, but small towns set in virgin bushland had a significantly lower isolation rate for M. intracellulare than did those with adjacent cultivation. The results of serotyping 30 isolates in the MAIS complex indicated that the commonest serotype was serotype 23, which was found in nine separate tanks, five of these being obtained from one area where cultivation extends for 50 km in a strip 5 km wide. Humans who consume the contaminated tank water are free of symptoms, but none have been medically examined. It is suggested that mycobacteria adhering to dust particles disturbed mechanical cultivation may be the source of contamination. (Baker-FRC)
W82-02069

USE OF KNOPP'S METHOD TO ASSESS SELF-PURIFICATION PROCESSES IN WATER BODIES AND WATER COURSES,
Byelorussia Univ., Minsk (USSR). Experimental Biological Special Topics Research Lab.
For primary bibliographic entry see Field 5B.
W82-02073

THE USE OF LEECHES TO IDENTIFY PESTICIDES IN WATER,
Akademiya Nauk SSSR, Borok. Inst. Biologii Vnutrennykh Vod.
L. N. Lapkina, and B. A. Flerov.
Hydrobiological Journal, Vol 16, No 3, p 78-83, 1980. 7 Fig, 2 Ref.

Descriptors: *Water analysis, *Pesticides, Agricultural chemicals, Chemical analysis, Bioassay, *Leeches, Toxicity, Organophosphorus compounds, Organochlorines, Organic pesticides, Bioindicators, *Pollutant identification.

Leeches of the family Hirudinidae were placed in glass jars with screw caps containing at least 200 ml of water per leech. Leeches were thus exposed to chlorophos, carbophos, rogor, sevin, polychloropinene, and lindane. Also tested were three pharmacological preparations: eserine, proserine, and armine. It is noted that the symptom of the toxic action of chlorophos and PCP on different species of leech indicates the possibility of using members of this class of worms to detect the presence of particular substances in water. The sensitivity and rapidity of this method of analysis differ in relation to the specific poison being studied and the species used. A poison concentration of 0.1 mg/l causes specific bending under of the hind segments in the medicinal leech within 40 min in sevin solutions, 3.5 hr in armine, and 27.5 hr in chlorophos. Deeper stages of intoxication, including shortening of the body, opening of the pharynx, phasic increase, and decline of mass are not reached under the effect of sevin and chlorophos at this concentration, but in armine solutions they are manifested within 7-8 hr. An increase of sevin concentration to 1 mg/l and of chlorophos to 0.3 mg/l leads to the manifestation of poisoning symptoms and to more rapid poisoning. The sensitivity of this method of analysis is of interest when compared with that of other methods of analysis for these contaminants in water. (Baker-FRC)
W82-02075

5B. Sources Of Pollution

SEDIMENT-CONTAMINANT TRANSPORT MODEL,
Battelle Pacific Northwest Lab., Richland, WA.
Y. Onishi.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107,

No HY9, p 1089-1107, September, 1981. 10 Fig, 20 Ref.

Descriptors: *Kepone, *Sediment transport, Sediment deposition, *Path of pollutants, Pesticides, Insecticides, Adsorption, *James River, Virginia, Model studies, Rivers, Suspended sediments, FETRA model.

An unsteady two-dimensional element model, FETRA, was developed to simulate sediment and pollutant transport in rivers and estuaries. It includes sediment/contaminant interactions such as adsorption and desorption of contaminants; and transport, deposition, and resuspension of contaminated sediments. The model handles three sizes of sediment separately. The sediment transport submodel includes mechanisms of: (1) advection and diffusion/dispersion of sediments; (2) fall velocity and cohesiveness, (3) deposition on the river bed, (4) erosion from the river bed, and (5) sediment contributions from point/nonpoint sources and subsequent mixing. The migration of sediment and the pesticide kepone, deposited in the James River Estuary, Virginia, in the early 1970s was simulated. During calibration the model was adjusted until total sediment concentrations at maximum ebb, slack tide, and maximum flood for a net fresh water river discharge of 58.3 cu meters per sec at River Mile 76 were reproduced. The model was verified for a net fresh water discharge of 247 cu meters per sec. The computed dissolved kepone concentrations were 0.0048-0.0084 micrograms per liter and the total kepone concentration, 0.007-0.017 micrograms per liter, with peak liter and the total kepone concentration, 0.007-0.017 micrograms per liter, with peak concentration at River Mile 48 at the maximum flood tide. The model suggests that suspended sediments carry 12-53% of the total kepone being transported, while 47-88% is dissolved. Over a tidal cycle the average kepone concentration was 0.0076 micrograms per liter, indicating that 14.0 kg of kepone is transported toward Chesapeake Bay each year at a fresh water discharge of 58.3 cu meters per sec. (Cassar-FRC)
W82-01614

MATACIL RESIDUE DETERMINATION IN FOLIAGE, FISH, SOIL AND WATER,
Mobay Chemical Corp., Kansas City, MO. Div. of Agricultural Chemicals.
For primary bibliographic entry see Field 5A.
W82-01621

INFLUENCE ON GROUNDWATER FROM THE BERMED INFILTRATION POND,
Dorchester County Health Department, Cambridge, MD.
For primary bibliographic entry see Field 5D.
W82-01622

NITROUS OXIDE EMISSION FROM SIMULATED OVERLAND FLOW WASTEWATER TREATMENT SYSTEMS,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
For primary bibliographic entry see Field 5D.
W82-01624

NITRATE REDUCTION TO AMMONIUM AND ORGANIC NITROGEN IN AN ESTUARINE SEDIMENT,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
R. J. Buresh, and W. H. Patrick, Jr.
Soil Biology and Biochemistry, Vol 13, No 4, p 279-283, 1981. 4 Tab, 17 Ref.

Descriptors: *Estuarine environment, *Chemical reactions, *Nitrogen, Nitrates, Ammonia, Sediments, Fate of pollutants, *Estuarine environment.

The probable magnitude of conversion of nitrate to ammonium and organic nitrogen in a flooded estuarine sediment was investigated. Sediment covered by a layer of water was incubated in unsealed containers open to the air. Nitrate was added to the overlying water of the sediment-water systems in order to simulate the fate of nitrate entering an anaerobic sediment zone from the overlying water column and aerobic sediment layer. The reduction of nitrate in nature is presumably better represented by this type of incubation technique than by one employing an inert gas atmosphere. In order to determine what effect the intensity of reduction has on nitrate reduction the influence of redox potential on nitrate reduction to ammonium was also investigated. Estuarine sediment was obtained with a Peterson dredge from the bottom of a shallow lake in coastal Louisiana. Total N content, total C content, and pH of the sediment were 0.52, 7.8, and 7.4%, respectively. Water salinity and pH in the lake from which the sediment was obtained were 20 mg/ml and 7.8, respectively. The study showed that after the addition of labelled nitrate to the sediment-water systems the quantity of labelled organic N continually increased with time, whereas labelled ammonium-nitrogen initially increased more rapidly, but then decreased. These trends suggest that at least some labelled ammonia formation preceded production of labelled organic nitrogen. Dissimilatory reduction of nitrate to ammonia and subsequent incorporation of the ammonia into organic matter was the probable mechanism for the formation of labelled ammonia and organic nitrogen. The results of the study suggest that only about 15% of the nitrate reduced in the examined estuarine sediment was reduced to ammonia and recycled in the sediment. (Baker-FRC)
W82-01625

A GRAPHICAL APPROACH TO PREDICTION OF GROUNDWATER POLLUTANT MOVEMENT,
North Carolina State Univ. at Raleigh. Dept. of Marine Earth, and Atmospheric Sciences.
C. W. Welby.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 237-243, August, 1981. 8 Fig, 8 Ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Waste disposal, *Flow nets, Landfills, Model studies, Geohydrology, Mathematical studies, Graphical methods, Leachates, Graphical analysis, Flow pattern, Fate of pollutants, Water pollution effects, Prediction, Groundwater pollution.

In analyzing a potential or actual groundwater pollution problem, it is important to accurately estimate when and where the contaminant may come into contact with the biological realm and the amounts that may appear at an outflow boundary over a period of time. Geography-time distributions and geography-quantity distributions are useful aids in making decisions concerning waste disposal processes. A method using contour maps and simple graphs and based on flow net and vector analyses allows for prediction of pollutant arrival times at an outflow boundary and variations of pollutant concentrations across that boundary in space and with time. Macro- and megascale aspects of groundwater pollution may be studied with this procedure. The technique may be applied to problems of potential groundwater pollution by sanitary landfill leachate, leaks from waste-holding ponds, or leaks from underground gasoline storage tanks. The present method may also be used in reconnaissance studies for evaluating hazardous waste sites using available hydrogeologic data. In addition, the method can be used for site evaluation and for the prediction of long-term downstream effects of contaminant leakage from a disposal site. (Geiger-FRC)
W82-01634

PERSPECTIVE ON MANAGEMENT AND DISPOSAL OF HAZARDOUS WASTES,
North Carolina State Univ. at Raleigh. Dept. of Marine Earth and Atmospheric Sciences.
For primary bibliographic entry see Field 5E.
W82-01635

TEMPORAL AND SPATIAL VARIATIONS OF MERCURY, LEAD, ZINC, AND COPPER IN SEDIMENTS OF THE SAGUENAY FJORD,
Laval Univ. (Quebec). Dept. of Chemistry.
C. Barbeau, R. Bougie, and J-E. Cote.
Canadian Journal of Earth Sciences, Vol 18, No 6, p 1065-1074, June, 1981. 7 Fig, 4 Tab, 20 Ref.

Descriptors: *Sedimentation rates, *Heavy metals, *Fjords, Canada, Mercury, Lead, Zinc, Cores, *Saguenay Fjord, Quebec.

This paper examines trace metal contents of core sediments taken in the Sanguenay fjord in relation to the dating provided by cesium-137 and the industrial and geological events up to 1978. Core sediment samples were taken in 1976 and 1978. The upper part of most cores contained high concentrations of mercury and decreasing concentrations of lead and zinc. The thickness of mercury-enriched sediments varied from high in the northern basin to low in the southern and intermediate basins, with an increase in the western basin. Except for the increased consumption of gasoline after the Second World War, there is no chronological mark related to lead in the Saguenay region. The pre-1940 period is characterized by an average concentration of 17 microg/g of lead, with the highest values close to 40 microg/g. Post-1940 concentrations are of an average 45 microg/g. The narrow range of concentration and the average values of 85 and 21 microg/g for zinc and copper in pre-1940 sediments indicate that not much enrichment of the sediments took place before 1940. The enrichment factor during the post-1940 period is identical for both elements, but much smaller than for lead. It was concluded that the northern basin of the fjord holds most of the anthropogenic material, but the accumulation rates and loadings vary significantly inside the basin. More than 50% of the sediments settle in the southern part of the basin. Material from the 1971 Saint-Jean-Vianney landslide is present in most parts of the basin and has modified the quality of sediments until at least 1976. Mercury input is below 0.5 microg/g in fresh sediment since 1970. (Baker-FRC)
W82-01639

COOLING POTENTIAL OF MISSOURI RIVER IN MISSOURI,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
A. R. Giaquinta.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 106, No HY11, p 1813-1825, November, 1980. 3 Tab, 4 Fig, 7 Ref. OWRT-B-061-IA(3).

Descriptors: *Rivers, *Thermal properties, *Cooling, *Electric powerplants, Effective capacity, Temperature effects, Water temperature, Water cooling, Condensers, Powerplants, Ecology, Energy, Climatic data, Flow, Thermal capacity, Reservoirs, *Missouri River, Missouri.

The steady-state Iowa Thermal Regime model was used to determine the thermal regimes of the Missouri River along a study reach corresponding to average meteorological and hydrological conditions for one month of each of the four seasons. The natural and modified thermal regimes resulting from the imposition of external heat loads from power plants and other sources are calculated. Results are shown in the form of temperature distributions along the river for the cases of both existing power plants and power plants proposed for installation within the next decade. Based on the existing thermal standards of the state regulatory agencies, the remaining heat assimilation capacity of the river is computed, and sites and capacities of future permissible once-through-cooled power plants of a reasonably large size are determined. The resultant temperature distributions corresponding to these future permissible plants are also presented. No remaining heat assimilation capacity in the vicinity of Kansas City exists. No additional power plants upstream from Kansas City could be installed because of their downstream effects. At the low flow conditions, some existing and proposed power plants can violate the excess temperature limitation if they operate at full load. The total future permissible plant capacity, based on low flow conditions, is about 1300 NW for fossil-fueled plants. (Titus-FRC)
W82-01654

PERIPHYTIC COMMUNITY RESPONSE TO CHRONIC NUTRIENT ENRICHMENT BY A RESERVOIR DISCHARGE,

Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
For primary bibliographic entry see Field 5C.
W82-01658

SEDIMENT BACTERIAL INDICATORS IN AN URBAN SHELLFISHING SUBSTUARY OF THE LOWER CHESAPEAKE BAY,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5A.
W82-01661

NUTRIENT RUNOFF FROM AGRICULTURAL AND NON-AGRICULTURAL WATERSHEDS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Agricultural Engineering.
M. D. Smolen.
Transactions of the ASAE, Vol. 24, No. 4, p 981-987, July/August, 1981. 4 Fig, 5 Tab, 15 Ref. OWRT-A-058-VA(4).

Descriptors: *Watersheds, *Nutrient removal, Nitrogen, Phosphorus, Leaching, Rainfall, Land use, Farming, *Agricultural runoff.

This study was designed to assess changes in the nitrogen and phosphorus content of stream water attributable to agricultural cropping activity. The background nutrient content was examined as represented by the non-agricultural control watershed. While sediment is considered important, it was not measured directly. Three adjacent watersheds at the Institute near Blackstone, Virginia were selected for hydrologic and water quality monitoring. They had been out of agricultural production for the preceding 35-40 years. In 1975 and 1976 corn and grasses were planted over large areas. Most fertilizer applications occurred during these two years. In subsequent years most of the fertilizer was associated with small plot research. The findings of the study indicate that agricultural activity caused a significant increase in nitrogen and phosphorus concentration and yield. Spring and fall nitrogen and phosphorus peak concentrations occurred earlier in the treated watershed and paralleled the timing of cultural activity. Background water quality, as represented by the control watershed, showed extremely low inorganic nitrogen content. Although there was a 2.5 to 3-fold increase in total phosphorus content in the treated watershed, there was little increase in soluble orthophosphate concentration. Essentially all of the excess phosphorus attributable to agricultural cropping activity was found in the organic and particulate bound fraction, which may be amenable to control by soil conservation practices. Mass balance of the inorganic nitrogen input to the watersheds from rainfall and the export of total nitrogen in streamflow suggests that the control watershed was very nearly in equilibrium with respect to nitrogen. (Baker-FRC)
W82-01662

WATERSHED CONSTITUENT LOADING ANALYSIS UTILIZING EMPIRICAL HYDRO-CHEMICAL MODELING TECHNIQUES,
Utah State Univ., Logan.
J. S. Fifield.
PhD Dissertation, 1980. 230 p, 26 Fig, 22 Tab, 65 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-05104.

Descriptors: *Watersheds, *Model studies, Salts, Chemistry, Colorado River, *Salinity, *Dissolved solids, Path of pollutants, *Salt loading, Stream loading, Hydro-chemical models, Basin constituents.

In studying the hydrochemical characteristics of a watershed, a valuable tool available to engineering lies in utilization of computer models. One stochastic, one lump parameter and 13 deterministic models were reviewed and analyzed for technique, assumptions, data requirements and ability to simulate the hydrology and chemical system of a basin. In order to obtain sufficient chemical data at a low cost, it was proposed that complex chemical agorithms might be adequately represented by the results of empirical analysis that utilize only stream quantity and quality data. Concluding that complex algorithms can be adequately represented by the results of empirical analysis resulted in the modification of a hydrologic model to a hydrochemical model. The modified deterministic model was calibrated on 80,200 acres of the Grand Valley, Colorado. Subsequent management runs indicate that only a net minimal reduction of salt loading to the Colorado River will be realized by lining canals, laterals and ditches whereas substantial reduction will result upon increased farm efficiency and/or reduction of spills. When optimal management conditions are met, sulfate will decrease the most and potassium the least. A reduction in the amount of data needed to perform basin with hydrochemical research of salt loading to a stream is realized thus resulting in lower costs for calibration and management studies utilizing deterministic models. (Sinha-OEIS)
W82-01676

BIOLOGICAL AND PHYSICAL INVESTIGATIONS OF BODIES OF WATER BENEATH DENSE WATER HYACINTH POPULATIONS BEFORE AND AFTER CHEMICAL TREATMENT,
Florida Univ., Gainesville. Dept. of Botany.
W. W. Brower, II.
PhD Dissertation, 1980. 277 p, 122 Fig, 5 Tab, 23 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX 81-05560.

Descriptors: *Water quality, *Aquatic weeds, *Herbicides, Water hyacinth, Chemical treatment, *Ponds, Weed control, Eichhornia crassipes.

Dense infestations of water hyacinths or other free-floating, mat-forming aquatic weed species, dramatically affect the water quality below them. Hyacinth mats were chemically treated with 2,4-D, which proved to be an efficient means of aquatic weed control. After chemical teatment, floating mats of dying hyacinths were persistent on the pond surfaces for several months. Water quality under the decaying mats was worse than under actively growing hyacinths. Phytoplankton and zooplankton populations were much reduced while the periphyton diatom populations were variable. Open water conditions were established approximately six months after herbicide application, and water quality slowly improved. Phytoplankton populations were large after hyacinth treatment and disappearance, being mostly composed of blue-green algae, but with occasional large seasonal green algae populations. Periphyton diatom populations increased in both the pond surfaces and depths. Zooplankton populations were reduced after open water conditions were established and were largely composed of various rotifers and crustaceans. Sedimentation was 5.8 times greater after herbicide application. (Sinha-OEIS)
W82-01678

GEOGRAPHIC VARIATIONS IN WATER QUALITY AND RECREATIONAL USE ALONG THE UPPER WALLOWA RIVER AND SELECTED TRIBUTARIES,
Oregon State Univ., Corvallis. Dept. of Geography.
For primary bibliographic entry see Field 5A.
W82-01681

TOXIC SUBSTANCES IN WATER: PATTERNS OF CONTAMINATION AND POLICY IMPLICATIONS,
Rutgers - the State Univ., New Brunswick, NJ.
For primary bibliographic entry see Field 5A.
W82-01695

ECOLOGICAL AND PHYSIOLOGICAL FEATURES OF THE ROOT SYSTEM OF INSHORE HYDROPHYTES,
Ukrainian Academy of Sciences, Kiev (USSR). Institute of Hydrobiology.
N. N. Smirnova.
Hydrobiological Journal, Vol 16, No 3, p 38-48, 1980. 106 Ref.

Descriptors: *Self-purification, *Aquatic plants, *Swamps, Wetlands, *Hydrophytes, Calcium, Potassium, Nitrogen, Phosphorus, Metabolism, Roots, Nutrients, Eutrophication, Water quality, Literature review, Hydrobiology, Fate of pollutants, Nutrients.

Data concerning anatomy, morphology and metabolism peculiarities of higher aquatic plants and their root systems was analyzed. The structural functional features of the plants' growth under different ecological conditions are studied. In contrast to terrestrial plants, the root system of hydrophytes is permanently located in a bottom material that is supersaturated or inundated with water. Among the higher water plants there have been appreciable phylogenetic changes of anatomical and morphological structure, especially in the root system. Inshore hydrophytes are a transitional form between land plants and true hydrophytes, and consequently their anatomical and morphological structure has typical attributes of both. The specific habitat of aquatic and swamp plants has promoted the development of anatomical and morphological features, ensuring the normal gaseous metabolism of the root system with receipt of sufficient oxygen from the atmosphere by the subterranean organs. The self-purification of water bodies results from physicochemical processes and from the activity of hydrobionts. The absorbing capacity of higher water plants is most important in this regard. The absorbing function of the root system is expressed to different degrees in highly hydrophilous plants in relation to the chemical nature of the water and the reserves of nutrients in the bottom deposits. The most important chemical elements for determining the degree of eutrophication of water bodies, such as nitrogen, phosphorus, potassium, and calcium, may be removed from circulation in a water body for a fairly long time by means of reeds, reedmance, bulrushes, and reed sweetgrass. The subaerial portion of the plant biomass may be harvested at the end of the growing season, thus removing these chemicals more completely. (Baker-FRC)
W82-01715

FORMATION OF WATER QUALITY IN THE IRTYSH-KARAGANDA CANAL,
Ukrainian Academy of Sciences, Kiev (USSR). Institute of Hydrobiology.
O. P. Oksiyuk, G. N. Oleynik, G. B. Tulepova, A. N. Timerkayeva, and E. G. Belobaba.
Hydrobiological Journal, Vol 16, No 3, p 31-38, 1980. 7 Fig, 9 Ref.

Descriptors: *Canals, *Water quality, *Bacteria, *Aquatic plants, Nitrogen, Organic matter, Minerals, Plankton, Water pollution sources, Aquatic life, Water conveyance, Water transfer, *Irtysh-Karaganda Canal, *USSR, Diversion channels.

The Irtysh-Karaganda canal was constructed to convey water to the industrial regions of the dry area of Central Kazakhstan. Its source of water is the Belaya River, an arm of the Irtysh. The overall length of the canal is 457 km. The canal is intended to receive local runoff, the bulk of which enters it during the flood period. The canal and its reservoirs are intensively overgrown with higher water plants, forming a large phytomass and appreciably affecting water quality. Monthly data on hydrochemical, bacteriological and hydrobiological indices covering a two-year period at fixed observation points along with the results of an expedition study in July 1977-1979 provided material for this study on water quality formation along the canal. In the spring, permanganate oxidizability (PO) is mainly attributable to the local runoff entering the canal at flood time. Values are especially high in the middle part of the canal. After the water has passed through the reservoirs PO increases, and it continues to increase to the end of the canal. The water in the canal is gradually enriched with organic matter in July, with evidence indicating an increase in bichromate oxidizability as the water passes through the reservoirs and comes to the end of the canal. The concentration of ammonia nitrogen in the canal water is low. The dynamics of mineral forms of nitrogen in the canal are not uniform. In the first third of the canal the abundance of bacterioplankton is slightly reduced, but after the reservoirs it increases to the level on entry. The quantity of heterotrophic bacteria in

flood water varies widely. Distribution of bacteria of the E. coli group and the distribution of dry residue are considered briefly. (Baker-FRC)
W82-01716

DISTRIBUTION OF VIBRIO PARAHAEMOLYTICUS IN FINFISH HARVESTED FROM PORTO NOVO (S. INDIA) ENVIRONS: A SEASONAL STUDY,
Center of Advanced Study in Marine Biology, Porto Novo (India).
For primary bibliographic entry see Field 5A.
W82-01737

EFFECTS OF A CATTLE FEEDLOT ON GROUND-WATER QUALITY IN THE SOUTH PLATTE RIVER VALLEY NEAR GREELEY, COLORADO,
Geological Survey, Lakewood, CO. Water Resources Div.
R. G. Borman.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-224321, Price codes: A05 in paper copy, A01 in microfiche. Geological Survey Water-Resources Investigations 80-83, 1981. 78 p, 14 Fig, 10 Tab, 19 Ref.

Descriptors: Water quality, *Groundwater pollution, Water pollution sources, *Feedlots, *Farm wastes, *Cattle, Nitrates, Leachate, Percolation, Observation wells, Water table, Chemical analysis, *Colorado, South Platte River valley.

Changes in water quality in an alluvial aquifer resulting from the operation of a feedlot stocked with 90,000 cattle have been minimal. Monitoring water quality in 19 observation wells from April 1974, prior to the operation of the feedlot, to June 1978, after about 4 years of operation, indicates that chloride concentrations have increased slightly in one well downgradient from a runoff-retention pond. Chemical analyses of water from two lysimeters installed in the unsaturated zone indicate that leachate from the feedlot has percolated to a depth of at least 5 feet but has not percolated to a depth of 20 feet. The small changes in groundwater quality caused by the feedlot are likely the result of the limited available recharge, a relatively impermeable manure pack, soil clogging under the cattle pens resulting in slow vertical movement of leachate through the unsaturated zone, soil clogging under the unlined runoff-retention ponds, and denitrification in the unsaturated zone. (USGS)
W82-01790

QUALITY OF WATER AND TIME OF TRAVEL IN PART OF TILLATOBA CREEK BASIN, MISSISSIPPI, OCTOBER 1974 TO SEPTEMBER 1980,
Geological Survey, Jackson, MS. Water Resources Div.
For primary bibliographic entry see Field 7C.
W82-01791

PERSISTENCE OF 3-(TRIFLUOROMETHYL)-4-NITROPHENOL IN AQUATIC ENVIRONMENTS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
D. A. Thingvold, and G. F. Lee.
Environmental Science and Technology, Vol 15, No 11, p 1335-1340, November, 1981. 6 Fig, 1 Tab, 30 Ref.

Descriptors: *3-(Trifluoromethyl)-4-nitrophenol, *Fish management, *Degradation, Lamprey, *Great Lakes, Pesticides, *Larvicides, Fate of pollutants, Microbial degradation, Phenols, Organic compounds, Lakes, Aquatic environment.

A sea lamprey larvicide, 3-(trifluoromethyl)-4-nitrophenol (TFM), did not degrade chemically or microbially in sediment-free water over an 80 day test period in the laboratory. Added since 1958 to tributaries of the Great Lakes, the chemical enters the lakes and persists for extended periods. It is expected that the level could approach 0.015 micrograms per liter, considerably less than levels harmful to nontarget aquatic life. The LC50 for rainbow trout is 0.53 to 40 mg per liter, depending on life stage. No degradation was evident with organisms derived from sediments, lake water, activated sludge, raw sewage, river water, and with microorganisms adapted to small amounts of TFM. Nutrient enrichment studies with sucrose and glucose-glutamate produced no TFM degradation. In a cometabolism test with sodium benzoate, the benzoate was metabolized, but the TFM remained. Although no degradation was seen in these aqueous system tests, decomposition in sediments or by photolysis cannot be ruled out without testing. (Cassar-FRC)
W82-01798

OXIDATION OF PHENOLIC ANTIOXIDANTS IN A RIVER SYSTEM,
Midwest Research Inst., Kansas City, MO.
V. Lopez-Avila, and R. A. Hites.
Environmental Science and Technology, Vol 15, No 11, p 1388-1390, November, 1981. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Phenols, *Chemical wastewater, *Organic compounds, Antioxidants, Fate of pollutants, *Path of pollutants, Sediments, Oxidation-reduction potential, Quinones, *Pawtuxet River, Rhode Island, Chemical industry, Rivers.

The general environmental fate of phenolic antioxidants in river systems is transformation into quinones or quinone methides. The formation of 2,6-di-tert-butylbenzo quinone from 2,6-di-tert-butylphenol (BHT), an antioxidant, was studied in sediment cores near to and 1 km downstream from a plant on the Pawtuxet River, Rhode Island, where antioxidants are manufactured. The phenol is oxidizing to the quinone up to the 18 cm depth in the near-plant sediment core and up to the 36 cm depth in the downstream core; below that depth the opposite reaction is occurring. Considering the sedimentation rates, these transformation depths are at 9 years ago (near-plant) and 12 years ago (downstream). An unknown compound, later identified as 2,6-tert-butylbenzoquinone 4-(carboxymethyl)methide, was observed at concentrations of 20 ppb in river water but not in wastewater. This is an oxidation product of the methyl and octadecyl esters of 3-(3,5-di-tertbutyl-4-hydroxy) propionic acid, also antioxidants manufactured at the plant. (Cassar-FRC)
W82-01801

ORGANIC COMPOUNDS FOUND NEAR DUMP SITES IN NIAGARA FALLS, NEW YORK,
Indiana Univ. at Bloomington. Dept. of Chemistry.
V. A. Elder, B. L. Proctor, and R. A. Hites.
Environmental Science and Technology, Vol 15, No 10, p 1237-1243, October, 1981. 1 Fig, 7 Tab, 12 Ref.

Descriptors: *Water pollution sources, *Waste disposal, *Chemical wastes, Organic compounds, *Waste dumps, Landfills, *Love Canal, Niagara River, Rivers, Industrial wastes, New York.

This paper reports the identification of antrhopogenic organic compounds at three sites in and near the Niagara River, in the city of Niagara Falls, New York. The 102nd Street dump site forms a bay 0.8 km long and 0.4 km wide which is actually part of the Niagara River. Four different dump sites make up the shoreline of the 102nd Street bay. It also receives runoff from the Love Canal area through a storm sewer. Another site was Bloody Run Creek, which is 200 meters long and is little more than a drainage ditch for the Hyde Park landfill. The third sampling site was Gill Creek, which runs through an industralized complex. All sampling sites drain directly into the Niagara River. Seventy-nine organic compounds were found in the 102nd Street bay area, Bloody Run Creek, and Gill Creek. Most were present at levels of 0.1 to 1 ppb. Compounds which had been dumped in large amounts were detected in most water and sediment samples. Large amounts of chlorinated benzenes and toluenes were found at all three sites. Other compounds included chlorotoluenes, polycyclic aromatic hydrocarbon derivatives, PCBs, trichlorophenol and other phenols, benzotrifluorides, mirex, and phenothiazine. A large number of benzyl derivatives and a few unusual fluorinated compounds were also found. These were probably waste byproducts of the industrial chemical production of benzyl chloride and (trifluoromethyl)chlorobenzene, respectively. These hazardous waste disposal sites were the major sources for most of the compounds identified. (Baker-FRC)
W82-01802

ENVIRONMENTAL ASSESSMENT OF INDUSTRIAL DISCHARGES BASED ON MULTIPLICATIVE MODELS,
Environmental Protection Agency, Research Triangle Park, NC.
M. R. Leadbetter, and W. G. Tucker.
Environmental Science and Technology, Vol 15, No 11, p 1355-1360, November, 1981. 1 Fig, 1 Tab, 6 Ref.

Descriptors: *Industrial wastewater, *Water pollution sources, Fate of pollutants, Wastewater disposal, Variability, *Model studies, Mathematical studies, Mathematical models, Effluents, Statistics, Errors.

The severity of a substance in an industrial discharge is defined as the ratio of the substance concentration to an estimated safe level. If the ratio is greater than 1, the source is classified as dirty, and if less than 1, as clean. When severities downstream from the source are of interest, a transport model must be used to relate the concentrations to factors measured at the source. Use of a multiplicative model on an effluent discharge from an industry is illustrated. The model is designed to classify a large number of the clean-dirty borderline cases as dirty, while minimizing the number of rather clean sources which are classified incorrectly. Another illustration using a textile plant effluent measured total suspended solids over 40 days to produce 57 observations. Considering only one measurement, 47 of the 57 cases were designated as dirty, but taking two observations on each of five representative days produced a clean classification. Severity at a downstream point can be calculated using concentration of pollutant in effluent, effluent discharge rate, river flow rate, and the standard concentration. (Cassar-FRC)
W82-01808

PREDICTING PRIORITY POLLUTANTS FROM PETROCHEMICAL PROCESSES,
Environmental Protection Agency, Washington, DC.
H. E. Wise, Jr., and P. D. Fahrenthold.
Environmental Science and Technology, Vol 15, No 11, p 1292-1304, November, 1981. 5 Fig, 5 Tab, 6 Ref.

Descriptors: *Chemical wastewater, *Organic compounds, *Priority pollutants, Water pollution sources, Chemical industry, Nitrophenols, Nitrogen compounds, Polynuclear aromatic hydrocarbons, Plastics, *Petroleum products, Metals, Chlorinated hydrocarbons, Aromatic compounds, Phenols, Nitrosamines, Chlorophenols.

Characterization of wastewater effluent from 172 commercial products and processes at 40 sites in the organic chemical, plastics, and synthetic fiber industries revealed that priority pollutants were associated with certain combinations of precursors and generic processes. Although the precursors and processess are widely used, it is only the particular critical combinations that produce priority pollutants. Most of these are associated with the early stages of production and are generally refined away on the route to the commercial product. Of the 116 recognized organic priority pollutants, 75 were verified in this study. Although some feed stocks such as acrylonitrile, phenol, and vinyl chloride are themselves priority pollutants, some are also introduced as impurities or reaction products of impurities in feedstocks or solvents. A table lists the 17 plastics and synthetic fibers effluents which contained greater than 0.5 ppm of priority pollutants, the monomers, and the chemical nature of pollutants generated. A similar table lists 71 organic chemical effluents which contained greater

than 0.5 ppm priority pollutants, with the generic processes, feedstocks, and chemical nature of pollutants generated. (Cassar-FRC)
W82-01809

COMPOSITION OF LEACHAGE FROM SURFACE-RETORTED AND UNRETORTED COLORADO OIL SHALE,
Colorado Univ at Boulder. Dept. of Geological Sciences.
K. G. Stollenwerk, and D. D. Runnells.
Environmental Science and Technology, Vol 15, No 11, p 1340-1346, November, 1981. 2 Fig, 5 Tab, 47 Ref.

Descriptors: *Leachates, *Oil shale, *Solute transport, Fate of pollutants, Water pollution sources, Colorado, Trace elements, Metals, Dissolved solids, Water quality, Waste characteristics, Mine wastes, Molybdenum, Arsenic, Selenium, Boron, Fluorine.

Groundwater and surface water in the Piceance Creek Basin, Colorado, may become contaminated by elements leached from retorted and fresh oil shale if development of this resource proceeds in this region. Laboratory leaching studies determined that a typical initial leachage composition from shale piles would probably contain the following pollutants (in mg per liter): fresh oil shale--total dissolved solids (TDS) 18000, Mo 9, B 32, F 16; Paraho retorted oil shale--TDS 28000, Mo 3, B 3, F 10; TOSCO II retorted oil shale--TDS 55000, Mo 9, B 18, F 19. The elements As and Se appear to present no threat to water quality. It is predicted that Mo would be present as Mo04(2-), boron as B(OH)3 and B(OH)4(-), and fluorine as free F(-). Although sulfuric acid would be generated, the abundance of carbonates and alkaline soils in this region would neutralize most of the acid, preventing acid pollution problems. The degree of leaching and contamination depends on many factors: chemical composition of the oil shale, presence of readily soluble minerals, temperature and atmosphere in retort, particle size distribution of retorted oil shale, annual precipitation, and location of shale pile in the drainage basin. Although the initial leachage would not meet recommended water quality criteria, the concentrations of TDS, Mo, and B would be reduced after passage of 1 or 2 pore volumes of water through the shale. This might require 1 or 2 centuries. F would remain at high concentrations, however, (Cassar-FRC)
W82-01810

INVESTIGATION OF SELECTIVE UPTAKE OF POLYCHLORINATED BIPHENYLS BY SPARTINA ALTERNIFLORA LOISEL,
North Carolina State Univ. at Raleigh. Pesticide Residue Research Lab.
E. Mrozed Jr., and R. B. Liedy.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 481-488, October, 1981. 1 Fig, 2 Tab, 5 Ref.

Descriptors: *Estuarine environment, *Polychlorinated biphenyls, *Aquatic plants, Adsorption, Accumulation, Chromatography, *Path of pollutants, Metabolism.

The movement of chlorinated hydrocarbons in the estuarine ecosystem and the role of Spartina alterniflora Loisel in this movement have been investigated. Specifically, the study was designed to provide evidence that S. alterniflora represents a potential pathway for the movement of PCB's in the estuarine system, to determine if uptake of PCB'S is a selective process, and to assess the effect of selective uptake on the reliability of concentration estimates based on the use of standard-sample chromatogram comparisons. A total of 0.3 mg of Aroclor 1254 was applied to 3.0 kg of washed coarse river bottom sand contained in buckets. Five S. alterniflora specimens were planted in each bucket of treated soil and immediately watered with nutrient solution. The final PCB concentration was 1.0 or 0.75 ppm based on soil dry weight or soil and water weight, respectively. Plants were harvested after a 90-day growth period with average minimum and maximum daily temperatures of 15.32 and 0.2 or 31.4 and 0.5 degrees C respectively. Samples were prepared for chromatography of soil, belowground tissues, and aerial tissues. The uptake of PCB's by S. alterniflora was shown to be selective for the lower chlorinated components of Aroclor 1254. Early peaks were enhanced relative to the standard in both types of plant tissue samples. Shifting of the chromatographic pattern of Aroclor 1254 as a result of PCB uptake indicates that this process changes the character of the PCB mixture. Enhancement of the early eluting components in belowground tissues is probably a result of the water solubility of the variously chlorinated congeners. Further shifting of the pattern towards the lesser chlorinated components in the aerial tissues suggests that some alteration of the mixture occurs within the plant. (Baker-FRC)
W82-01813

DENITRIFICATION ASSOCIATED WITH PERIPHYTON COMMUNITIES,
Geological Survey, Menlo Park, CA. Water Resources Div.
F. J, Triska, and R. S. Oremland.
Applied and Environmental Microbiology, Vol 42, No 4, p 745-748, October, 1981. 2 Fig, 13 Ref.

Descriptors: *Denitrification, *Cladophora, Chlorophyta, Streams, Rocks, Sedimentary rocks, Nitrous oxide, Algae, Nitrogen, Oxygen.

The periphyton community was examined in San Francisquito Creek, a small suburban drainage about 30 miles south of San Francisco. The community consisted of a Cladophora sp, mat which developed over the stream bed rocks. During summer low flows the filamentous mat undergoes senescence characterized by dense epiphtyic growth of diatoms, bacteria, and accumulation of fine organic particles which coat the filament surface. The fine particulates, when examined microscopically, contained a dense and diversified bacterial flora. Algal tissue were composited into a single sample. The scrapings of decomposing mats produced nitrous oxide when incubated under nitrogen plus 15% acetylene. Denitrification was enhanced by sodium nitrate and was inhibited by autoclaving, mercuric chloride, and oxygen. No nitrous oxide was formed without acetylene being present. Chloramphenicol did not inhibit nitrous oxide formation. Therefore the enzymes were constitutive. Incubation of periphyton scrapings in the light during field experiments inhibited denitrification due to algal photosynthetic oxygen production. The diurnal periphyton-associated denitrification rate was estimated to be 45.8 micromol of nitrous oxide per square meter per day as determined by averaging light, aerobic plus dark, and anaerobic rates over a 24 hr period. (Baker-FRC)
W82-01814

DISSOLVED HYDROCARBONS AND RELATED MICROFLORA IN A FJORDAL SEAPORT: SOURCES, SINKS, CONCENTRATIONS, AND KINETICS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
D. K. Button, B. R. Robertson, and K. S. Craig.
Applied and Environmental Microbiology, Vol 42, No 4, p 708-719, October, 1981. 5 Fig, 4 Tab, 37 Ref.

Descriptors: *Biodegradation, *Hydrocarbons, *Seawater, Toluene, Estuaries, Fjords, Harbors, Water pollution sources, Microbiological studies, Oil tankers, Water treatments, Ballast, Port facilities, Terpenes, Conifers, Alaska, *Port Valdez.

The dynamics of dissolved hydrocarbon metabolism in seawater were investigated. Shallow-water samples were taken from Port Valdez and from a more oceanic station in Prince William Sound. The study was performed by continuous addition of radiolabeled toluene, representing a solute component, of the treated oil tanker ballast water which is discharged at Port Valdez. At 0.5 micrograms of toluene added per liter, most rates of toluene oxidation were in the range of 1 to 30 pg/liter/hr. Near the ballast water injection point, a layer of warm ballast water, rich in bacteria, that was trapped below the less-dense fresh surface water was detected. Toluene residence times were about 2 weeks in this layer, 2 years elsewhere in Port Valdez, and 2 decades in the surface water of the adjacent, more oceanic receiving estuary. Mixing was adequate for a steady-state treatment; it was demonstrated that 98% of the toluene was flushed from Port Valdez before metabolism, giving a resultant steady-state concentration of 0.18 micrograms/liter. Total bacterial biomass from direct counts and organism size data was usually near 0.1 mg/liter. However, the values ranged up to 0.8 mg/liter in the bacteria rich layer. The origin of additional hydrocarbon source was sought to explain the observations that the population of toluene oxidizers was large with respect to the amount of toluene consumed and that water from a nearby, nonpolluted estuary was equally active in facilitating toluene metabolism. Terpenes can be washed from spruce trees by simulated rainfall, and thus riparian conifers may provide an additional and significant hydrocarbon source to seawater. (Baker-FRC)
W82-01816

A SURVEY OF TRIHALOMETHANES IN THE DRINKING WATER SYSTEM OF MURJREESBORO, TENNESSEE,
Middle Tennessee State Univ., Murfreesboro.
W. B. Kasso, and M. R. Wells.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 3, p 295-302, September, 1981. 4 Fig, 1 Tab, 10 Ref.

Descriptors: *Trihalomethanes, *Potable water, *Water treatment, Water pollution sources, Organic compounds, Disinfectants, Chlorination, Drinking water, *Murfreesboro, Tennessee.

A study was performed to establish consistent and accurate trihalomethane levels to which Murfreesboro residents are being exposed and to evaluate seasonal changes and patterns of THM concentrations as related to the distribution of drinking water. Murfreesboro is a city of about 35,000 persons located 30 miles southeast of Nashville. Two separate water treatment plants, each with distinct water sources, serve the community. Six sample sites were chosen, and sampling continued for a period of 10 months. Average chloroform levels in samples collected were lowest in the winter, of the three seasons monitored. Spring levels were slightly higher, and summer values were well above the maximum contamination levels of 100 ppb established by the EPA. Bromodicloromethane concentrations followed a similar seasonal pattern, while chlorodibromomethane levels were relatively steady during the 10 months. Three sites averaged above the maximum allowable total trichloromethane contamination level of 100 ppb, with highest concentrations again in summer. These sites were fed entirely by a specific water plant. The variation from site to site was attributed mainly to the differences in source water plants and the distance of each site from the respective water plant. The plant with the highest levels of chloroform obtained its raw water from the Stones River; the other water treatment plant obtained its raw water from groundwater sources. Various methods of improving the quality of water at the substandard plant are briefly considered. (Baker-FRC)
W82-01817

FATE OF KEPONE AND MIREX IN A MODEL AQUATIC ENVIRONMENT: SEDIMENT, FISH, AND DIET,
Missouri Univ.-Columbia. School of Forestry, Fisheries and Wildlife.
D. R. Skaar, B. T. Johnson, J. R. Jones, and J. N. Huckins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 3, p 931-938, August, 1981. 6 Fig, 35 Ref.

Descriptors: *Kepone, *Mirex, *Food chains, *Fate of pollutants, Pesticide residues, Insecticides, Bluegills, Fish, Daphnia, Aquatic environment, Degradation, Sediments, Accumulation, Metabolism, Chlorinated hydrocarbons.

Kepone and mirex did not degrade after 56 days' incubation in freshwater sediments under aerobic or anaerobic conditions and moved through a daphnia-bluegill food chain. A concentration of 0.1

micrograms per g of either insecticide labeled with C14 showed no primary or biological degradation in two sediments, one from kepone-contaminated Bailey Creek and one with no kepone contamination. After 28 days exposure to 0.046 plus or minus 0.01 mg per kg in food and 158 plus or minus 13 ng per liter in water, bluegills contained 1.68 plus or minus 0.11 mg per kg kepone, mean total body residue. The accumulation factor was 10,606. Equilibrium had not been reached during the test. The estimated half life of kepone in these fish was 25 days. Mirex exposure for 28 days at 0.24 plus or minus 0.05 mg per kg in food and 161 plus or minus ll ng per liter in water produced a mean total body residue of 1.98 plus or minus mg per kg. The accumulation factor was 12,274, with no significant elimination in mirex-free water. Neither insecticide was metabolized by the fish. Bluegills exposed to insecticide-free water and fed contaminated daphnia for 28 days accumulated 0.036 plus or minus 0.005 mg per kg kepone and 0.143 plus or minus 0.29 mg per kg mirex for mean total residues of 0.078 plus or minus 0.020 mg per kg kepone and 0.125 plus or minus 0.037 mg per kg mirex. The fish accumulated twice as much DDT under similar conditions. (Casar-FRC)
W82-01820

DETERMINATION OF MINERAL FIBER CONCENTRATIONS IN FISH TISSUES,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5C.
W82-01822

POTENTIAL FOR BIODEGRADATION OF PHTHALIC ACID ESTERS IN MARINE REGIONS,
Rosenstiel School of Marine and Atmospheric Science, Miami, FL.
B. F. Taylor, R. W. Curry, and E. F. Corcoran.
Applied and Environmental Microbiology, Vol 42, No 4, p 590-595, October, 1981. 3 Fig, 4 Tab, 26 Ref.

Descriptors: *Organic compounds, *Biodegradation, *Bacteria, Estuaries, Seawater, Rivers, Mississippi River, Deltas, Marine sediments, Phthalate esters, Marine environment, Sediments, Fate of pollutants.

This paper describes the presence of bacteria which aerobically degrade phthalic acid and phthalic acid esters (PAEs) in water and sediments from marine sources. This potential for PAE degredation was determined by comparing the counts of bacteria which grew aerobically on dibutyl phthalate (DBP) with the total counts of aerobic heterotrophic bacteria. The study took place in the Mississippi River estuary. Water samples and surface sediments from freshwater and marine environments were also collected from the Miami region and the New Orleans delta region. Bacteria that grew aerobically on DBP and o-phthalic acid were readily detected in both sediments and water samples. Pure cultures of bacteria were isolated on seven different phthalic acid esters from freshwater and marine sources. The marine isolates were taxonomically diverse and grew on a variety of phthalic acid esters. Dibutyl phthalate and o-phthalic acid supported growth in full-strength synthetic seawater medium, but sodium-dependent catabolism was demonstrable only for o-phthalic acid. The present study indicates that a variety of bacteria exist in some regions that can degrade o-phthalic acid and its esters in marine media. (Baker-FRC)
W82-01829

VOLTAMMETRIC STUDIES ON THE STABILITY OF THE ZN(II) CHELATES WITH NTA AND EDTA AND THE KINETICS OF THEIR FORMATION IN LAKE ONTARIO WATER,
Kernforschungsanlage Juelich, G.m.b.H. (Germany, F.R.). Inst. fuer Chemie.
For primary bibliographic entry see Field 2H.
W82-01839

NITROUS OXIDE IN FRESHWATERS OF THE GREAT LAKES BASIN,
Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 2H.
W82-01841

TOXICITY AND BOD EFFLUENTS DERIVED FROM KRAFT PULPING OF AGED WOOD CHIPS,
A. Wong.
Pulp and Paper Canada, Vol. 82 No 7, p 33-34, 36-38, 40-41, July, 1981. 14 Fig, 2 Tab, 22 Ref.

Descriptors: *Pulp and paper industry, *Toxicity, Effluents, Kraft mills, Biological oxygen demand, *Industrial wastes.

The effects of pulping and aged wood chips on mill effluent quality, yield and quality of byproducts, and on pulp quality were studied. It was proposed that it might be possible for kraft mills to reduce their discharges of toxic substances by judicious storage of chips prior to pulping. An experimental chip pile was built at a bleached kraft mill. The bark content of the chips was about 6%. The temperature within the chip pile was monitored regularly at six different locations. The ambient air temperature appeared to have some effect on the interior temperature of the chip pile. Although the temperature in the center of the chip pile ranged from 30 degrees C near the start of the experiment to about 5 degrees C at the end of the test, it is not known whether there was a high microbiological activity within the pile at such temperatures. The toxicity of the blow liquor derived from the pulping of the aged lodgepole pine chips was decreased in comparison to that of blow liquor derived from the pulping of fresh wood chips, by as much as 39% for liquor which had been produced from 26 week old chips. For spruce chips there was no appreciable change in toxicity. A loss of acetone-soluble and ether-soluble extractibles for both pine and spruce chips took place during storage. The decrease in resin acids in blow liquor was noted to be greater for pine than for spruce in storage. The biological oxygen demand of pine and spruce blow liquors was not changed substantially over the 26 week chip storage period. It was concluded that the toxicity of the blow liquor derived from the pulping of aged wood chips was decreased slightly in comparison to that of blow liquor derived from the pulping of fresh wood chips. The yield and quality of tall oil also declined. The loss of turpentine yield for both chips was considerable. Burst and tear strengths of pulps produced from aged wood chips were not altered appreciably. (Baker-FRC)
W82-01845

LOADING ESTIMATES TO LAKE ERIE, 1967-1976,
National Water Research Inst., Burlington (Ontario).
For primary bibliographic entry see Field 5A.
W82-01852

VARIATIONS AND MECHANISMS OF ASBESTOS FIBRE DISTRIBUTION IN STREAM WATER,
National Water Research Inst., Vancouver (British Columbia). Pacific and Yukon Region.
For primary bibliographic entry see Field 5A.
W82-01853

INTERLABORATORY QUALITY CONTROL STUDY NO. 26, ARSENIC AND SELENIUM IN WATER,
National Water Research Inst., Burlington (Ontario). Water Quality Branch.
For primary bibliographic entry see Field 5A.
W82-01854

THE NATURAL ACIDITY OF SOME UNPOLLUTED WATERS IN SOUTHEASTERN ALASKA AND POTENTIAL IMPACTS OF ACID RAIN,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. W. Johnson.
Water, Air and Soil Pollution, Vol 16, No 2, p 243-252, August, 1981. 1 Fig, 3 Tab, 29 Ref.

Descriptors: *Organic acids, *Baseline studies, *Acid rain, *Acidic water, *Watershed models, Forest watersheds, Watersheds, Acidic soils, Bogs, Color, Hydrogen ion concentration, Alkalinity, Model studies, Minerals, Surface water, Anions, Cations, Sulfates, Alaska.

Near Petersburg, Alaska, natural, unpolluted waters draining surface soils and bog soils containing organic acids display pH values below 4.7. Nearby streams have pH values around 6 or slightly below. Studies were carried out to determine the role of carbonic and organic acids in forest soil leaching processes at this site as compared to others in Washington and Costa Rica. Water samples were collected and analyzed for color, pH, alkalinity and various minerals, anions and cations. Projections of the effects of acid rains and organic acids were formulated using a worst-case model. Results showed that the greatest potential declines in pH would occur in the already acidic waters, while very little change would occur in the near neutral waters. In neither case do the predicted changes in acidity present cause for alarm, since the occurrence of acidic precipitation is not common in this area at present. The findings of this forest watershed study may serve as background data in the event of future pollution by sulfate inputs. (Geiger-FRC)
W82-01867

DEPOSITION OF SULPHUR GASES FROM MULTIPLE SCATTERED SOURCES IN ALBERTA,
Department of Agriculture, Lacombe (Alberta). Research Station.
D. R. Walker, A. C. Dick, and M. Nyborg.
Water, Air, and Soil Pollution, Vol 16, No 2, p 223-231, August, 1981. 2 Fig, 6 Tab, 11 Ref.

Descriptors: *Water pollution sources, *Sulfur, *Fate of pollutants, *Air pollution effects, Path of pollutants, Industrial wastes, Air pollution, Sulfate, Environmental effects, Crop yield, Legumes, Rainfall, *Alberta, Canada.

The deposition of sulfur (S) on soils, plants, and free water surfaces was studied at 47 monitoring stations located in the Canadian provinces of Alberta and Saskatchewan. Results were analyzed in relation to sampling site distance from industrial S emission sources. Approximately 7 to 9 kilograms/hectare of sulfate sulfur was deposited annually in a 4600 sq km area containing or adjacent to ten S emission sources with provincially-set emission standards of 330 tons of S/day. The annual S deposition rate declined to 4 to 6 kilograms/hectare at distances of 40 or more km from the S emission sources. S levels in rainfall ranged from 0.7 to 3.9 kilograms/hectare in the high S emission area. Free-water surface sites within the high S emission area adsorbed 2 to 3 times the amount of S adsorbed at sites 40 or more km away from the S emission sources. Lower yields of legume crops were obtained for non-fertilized plots far away from S emission sites than for non-fertilized plots close to S emission sources. (Geiger-FRC)
W82-01868

THE MERCURY CYCLE,
Swedish Water and Air Pollution Research Lab., Goeteborg (Sweden).
C. Brosset.
Water, Air, and Soil Pollution, Vol 16, No 2, p 253-255, August, 1981. 1 Fig.

Descriptors: *Path of pollutants, *Mercury, *Lakes, *Water pollution, *Air pollution, Heavy metals, Precipitation, Metal complexes, Seasonal variation, Fate of pollutants, Hydrogen ion concentration, Pesticide kinetics, *Sweden.

An intensive study of Hg in air, precipitation, and lake water in Sweden has resulted in the development of a tentative model for the cycling of this heavy metal. In the ground layer air mercury is present mostly as a metallic vapor. The total concentration of Hg decreases, but the ratio of water-soluble Hg to total mercury increases, with height above the ground. Most of the water-soluble Hg is formed in the air by oxidation or methylation and

is wet and dry deposited in the water phase of terrestrial and aquatic systems. Deposited Hg is reduced to metallic vapor and temporarily or permanently bound to condensed phases. The reaction velocity of these processes determines the level of respective Hg compounds in the water phase. The reemission of mercury vapor into the atmosphere shows a seasonal variation, while the magnitude of reemissions is determined by specific properties of the local receptor. Data supporting the proposed mercury cycle is discussed. High concentrations of methylmercuric chloride generally are found in lakes with low water pH. Levels of this mercury compound in fish meat seem to be directly related to the concentration of methylmercuric chloride in lake water. (Geiger-FRC)
W82-01869

TRANSPORT OF NONPOLAR ORGANIC COMPOUNDS FROM SURFACE WATER TO GROUNDWATER. LABORATORY SORPTION STUDIES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschutz, Zurich (Switzerland).
R. P. Schwarzenbach, and J. Westall.
Environmental Science and Technology, Vol 15, No 11, p 1360-1367, November, 1981. 5 Fig, 5 Tab, 27 Ref.

Descriptors: *Organic compounds, *Sorption, *Infiltration, Fate of pollutants, Path of pollutants, Chlorinated hydrocarbons, Hydrocarbons, Leaching, Landfills, Groundwater recharge, Recharge, Water treatment, Aquifers, Sediments.

Sorption equilibria for low concentrations of nonpolar organic compounds of low to intermediate lipophilicity in a river water-groundwater infiltration system were described by the equation S = K sub p times C, where S = concentration in liquid phase. Sorption by aquifer materials was reversible. This relationship is important in several applications: treatment of river water by artificial or natural bank infiltration, artificial groundwater recharge, and leaching of pollutants from landfills. Laboratory experiments were conducted using toluene; di-, tri-, and tetramethylbenzenes; n-butylbenzene, tetrachloroethylene, chlorobenzene, and di-, tri-, and tetrachlorobenzenes with several sorbents (natural river and lake sediments, kaolin, silica, and activated sewage sludge). For a variety of sorbents, the partition coefficient for a particular compound can be estimated from its 1-octanol/water partition coefficient and from the organic carbon content of the sorbents if the amount of organic carbon is greater than 0.1%. The compounds under investigation were highly mobile in organic-poor sorbents. Flow velocities affected sorption kinetics and thus material transport. (Cassar-FRC)
W82-01873

THE SIGNIFICANCE OF WET AND DRY SYNOPTIC REGIONS ON LONG-RANGE TRANSPORT OF POLLUTION AND ITS DEPOSITION,
British Meteorological Office, Bracknell (England).
F. B. Smith.
Atmospheric Environment, Vol 15, No 5, p 863-873, 1981. 7 Fig, 4 Tab, 6 Ref.

Descriptors: *Pollutants, *Precipitation, *Fallout, Synoptic analysis, Rainfall, *Air pollution, Mathematical studies, Sulfur dioxide, Model studies.

This paper has developed the idea of Rodhe and Grandell for differentiating between synoptic regions with a high probability of rain and those with little or no rain in the average Lagrangian removal of sulfur pollution from air in the boundary layer. To describe this intermittent wet deposition, four simultaneous rate of change equations were presented and solved. The equations also include the effects of dry deposition, oxidation of sulfur dioxide to sulfate, and the probability that the pollution may be advected from dry regions into wet regions and vice versa. The wet deposition terms reflect the geographical variation of long-term average rainfall and the variation of the probability of rain with wind direction. The equations thus represent the average statistical fate of pollution on its way from its source to a specified receptor. As an example, the average wet deposition rates at Frankfurt for different wind directions were compared on the assumption that all the sulfur pollution originates from a ring of imaginary equal continuous sources 900 km upwind. Three main conclusions were reached. First, the wet depositions were significantly different from those obtained using the simple model which fails to differentiate between mobile wet and dry synoptic regions. Second, the results are somewhat insensitive to the selected magnitudes of the parameters, which is fortunate, as they are not accurately known. Third, the wet depositions are not highly sensitive to the upwind average rainfall probability distributions. Typically, variations of only 20% in average wet-deposition rates with wind direction are implied. (Baker-FRC)
W82-01877

TRANSPORT OF SALTS IN CATCHMENTS AND SOILS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Forest Research.
For primary bibliographic entry see Field 2G.
W82-01880

TOXICANT ACCUMULATION IN HYDROBIONT TISSUES FOLLOWING EFFLUENT DISCHARGE,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
For primary bibliographic entry see Field 5C.
W82-01919

BIODEGRADATION OF SODIUM ALKYLBENZENESULFONATE IN PLANKTON-CONTAINING POND WATER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. A. Potapova, N. P. Galagan, I. A. Babenko, and L. I. Bagnyuk.
Hydrobiological Journal, Vol 16, No 4, p 49-53, 1980. 1 Fig, 1 Tab, 9 Ref.

Descriptors: *Ponds, *Biodegradation, *Surfactants, *Bacteria, *Plankton, Dissolved oxygen, Sludge, Organic compounds, Industrial wastes, Fate of pollutants, Model studies, Water pollution effects.

This paper reports a small part of the current research on the biodegradation of sodium alkylbenzenesulfonate (SABS), an anionic surfactant, in model ecosystems of various complexity. The object of the study was to examine the decomposition of SABS in natural water containing plankton and the effect of SABS on the plankton biocenosis. The following parameters were investigated: temperature, pH of the medium, content of dissolved oxygen, total abundance of bacterioplankton and the ratio of morphological groups in it, bacterial destruction, aggregation, and dehydrogenase activity of the bacterioplankton. The degradation of the SABS was estimated from the alteration of its content in time. Experiments were carried out under laboratory conditions in June-July 1979. The aquaria were filled with pond water containing plankton and with the same water to which sludge from a pond had been added. Samples were taken on days 1, 3, 5, 10, 15, 20, 25, and 40. SABS was added to the experimental aquaria at a rate of 2 mg/l. The background SABS content in the control and experimental aquaria of both systems was 0.02-0.04 mg/l. The degradation of SABS within 40 days was complete in the system to which sludge was added, and 92% in the system without sludge. The addition of SABS did not affect dissolved oxygen content or the pH of the medium, but did change the structure and functional state of the bacterioplankton. Changes in bacterial destruction and in the aggregation of the bacterioplankton were dependent on the level of degradation of SABS and on the type of system, whereas changes in dehydrogenase activity were dependent solely on SABS concentration. A strong negative correlation between the aggregation of the bacterioplankton and bacterial destruction was noted. (Baker-FRC)
W82-01925

THERMOPHILLIC AND THERMOTOLERANT FUNGI ISOLATED FROM THE THERMAL EFFLUENT OF NUCLEAR POWER GENERATING REACTORS: DISPOSAL OF HUMAN OPPORTUNISTIC AND VETERINARY PATHOGENIC FUNGI,
Chicago Univ., IL. Dept. of Medicine.
J. W. Rippon, R. Gerhold, and M. Heath.
Mycopathologia, Vol 70, No 3, p 169-179, 1980. 1 Fig, 13 Tab, 22 Ref.

Descriptors: *Fungi, *Public health, *Thermal water, Fate of pollutants, Aspergillus, Pathogens, Cooling water, Thermophilic fungi, Powerplants, Quad Cities Power Plant, Illinois, Nuclear powerplants.

Samples of water, foam, microbial mat, soil, and air obtained near the Quad Cities Power Station, Illinois, during 1977-78 contained 53 species of thermotolerant and thermophilic fungi. Eleven species of opportunistic Mucocorales and Aspergillus and 1 veterinary pathogen, Dactylaria gallopava, were found in soil, water, foam, and mat in the intake bay, discharge bay, and cooling canal, where the water is warm. Aspergillus fumigatus was most numerous. In areas of cooler water the opportunistic fungi decreased in abundance. Air samples from 6 locations contained 9 species of fungi in low abundance. This study confirms that there is little public health hazard due to dissemination of thermophilic fungi from the power plant area to the environment. (Cassar-FRC)
W82-01928

ACID RAIN AGREEMENT,
R. J. Smith.
Science, Vol 209, No 4459, p 890, August 22, 1980.

Descriptors: *Acid rain, *International agreements, *Political constraints, Canada, Water quality control, Institutional constraints, Water pollution sources.

Scientific working groups from Canada and the U.S. have been established to prepare for acid rain negotiations scheduled for June 1981. The groups will take air samples and estimate impact of acid rain on the environment, determine the precise origin of acid rain, and develop a strategy for abatement. Some constraints on the negotiations are costs (potentially $400-500 million for Canada and 5 to 8 times that for the U.S. between now and 2000), the relative independence of Canada's provinces, and the U.S. utility lobby. (Cassar-FRC)
W82-01933

CHROMIUM LEVELS IN FISH FROM A LAKE CHRONICALLY CONTAMINATED WITH CHROMATES FROM COOLING TOWERS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
J. W. Elwood, J. J. Beauchamp, and C. P. Allen.
International Journal of Environmental Studies, Vol 14, No 4, p 289-297, 1980. 2 Fig, 4 Tab, 33 Ref.

Descriptors: *Chromium, *Fish, *Cooling water, Fate of pollutants, White Oak Lake, Melton Hill Reservoir, *Tennessee, *Reservoirs, Lakes, Chromates, Metals, Heavy metals, Bluegills, Mosquitofish, Bass, Absorption, Accumulation.

Chromium levels in fish were determined in White Oak Lake, contaminated with chromates from cooling water blowdown, and the nearby uncontaminated Melton Hill Reservoir. Total Cr levels (in mg per liter) in White Oak water were 0.1-0.3 in 1969, 0.1 in 1973, and 0.01-0.14 in 1974. Fish species were bluegill (Lepomis macrochirus), largemouth bass (Micropterus salmoides), goldfish (Carassius auratus), and mosquitofish (Gambusia affinis). Results suggest that Cr levels in muscle and whole body of most species analyzed are inversely related to fish weight. Mean Cr concentration (in micrograms per g) in bluegill were 1.22, muscle

and 1.45, whole body; and in largemouth bass 0.51, muscle and 0.82, whole body. There were no significant differences between Cr levels in: (1) bluegill vs. largemouth bass, (2) whole body vs. muscle tissues, and (3) fish from the contaminated vs. the uncontaminated reservoirs. Goldfish collected in 1969 contained 9.79 micrograms per g (whole body), and 0.92 micrograms per g in 1973. Feeding habits apparently did not affect Cr levels. It is possible that fish can regulate Cr concentrations actively by reduced absorption and/or increased secretion of Cr or passively by a limitation of binding sites, or that some of the Cr is in a non-absorbable form. (Cassar-FRC)
W82-01941

THE CONTAINMENT OF AN OIL SLICK BY A BOOM PLACED ACROSS A UNIFORM STREAM,
McGill Univ., Montreal (Quebec). Dept. of Civil Engineering and Applied Mechanics.
For primary bibliographic entry see Field 1B.
W82-01956

INORGANIC CHEMISTRY OF PARTICULATE MATTER FROM THE NEARSHORE ZONE OF LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes and Marine Waters Center.
For primary bibliographic entry see Field 2H.
W82-01959

SELENIUM: A WATER POLLUTANT FROM FLUE GAS DESULFURIZATION,
Slippery Rock State Coll., PA. Dept. of Chemistry.
W. G. Sayre.
Journal of the Air Pollution Control Association, Vol 30, No 10, p 1134, 1980. 1 Tab, 3 Ref.

Descriptors: *Selenium, *Industrial wastes, Water pollution sources, Groundwater pollution, Water quality, Drinking water, Public health.

Small discharges of the blowdown water from the scrubber loop of some flue gas desulfurization techniques could cause large scale problems of surface or groundwater pollution. This discharge would contain maximum SeO3(-2) concentrations of 15.2 mg/liter and maximum concentrations of SeO4(-2) of 1.1 times 10 to the 6th power mg/liter. The levels of selenate and selenite are many orders of magnitude larger than permissible levels for drinking water. (Small-FRC)
W82-01960

MIXING ZONE ANALYSIS FOR RIVER PLUMES,
Georgia Inst. of Tech., Atlanta. School of Civil Engineering.
P. P. Pialy.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 731-746, August, 1981. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Thermal pollution, *Mathematical models, *Temperature effects, Water pollution, Mixing, Nuclear powerplants, Water cooling, Water quality standards.

Steam-electric powerplants which utilize open-cycle cooling of plant condensors discharge heated water directly into natural water bodies. This results in the formation of thermal plumes in the receiving water in regions adjacent to the discharge outfall, with a mixing zone, in which the temperature gradient is largest, occurring near the outfall. Allowable maximum sizes for these mixing zones are usually specified for a given plant for both a seasonal mean flow condition and a seasonal worst-case flow, generally equal to the 7-day, 10-year low flow for the season. This paper describes a method for using field data from thermal plume surveys to develop mixing zone models capable of evaluating the effects of thermal discharges. These models can be used to develop proper compliance criteria for powerplant operations at low river flows. If the regulatory agency which routinely reviews and verifies the powerplant compliance with the applicable standards accepts and approves the data sets generated by these models for a given powerplant, it may waive the requirement for monthly plume surveys, which are commonly required under current regulations. (Carroll-FRC)
W82-01961

UPLAND MARSH FOR WATER QUALITY CONTROL,
Agricultural Research and Education Center, Lake Alfred, FL.
S. F. Shih.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 861-864, August, 1981. 1 Fig, 2 Tab, 3 Ref.

Descriptors: *Marshes, *Time series analysis, *Water quality control, Wastewater treatment, Wetlands, Nutrients, Mathematical studies, Vegetation, Plant growth, *Plant nutrient uptake.

Although many studies have investigated the use of vascular plants to improve the water quality of fresh water marshes, previous researchers have not emphasized the application of models to determine plant nutrient uptake in marshes. This study used time series analysis to analyze plant nutrient uptake, used the F-test as the statistical criterion to determine the possibility of any component existing in series, and demonstrated the application of time series analysis to interpolate missing data. Since plant nutrient uptake is a function of time, time series analysis can be used to observe the trends, cyclical movement, and residual pattern of a water quality system in marsh areas. Total phosphate data taken at 4 hour intervals over a 5 day period in September was used to demonstrate the application of time series analysis. The Fourier coefficients, amplitude, phase angle, and percent of variance were determined for each harmonic at three sampling sites. The Fourier analysis showed that three harmonics explained over 83 percent of the variance. The amplitudes were much smaller in the marsh than in the slough, confirming the reduction of total phosphate after the water flowed through the marsh zone. Interpolation of missing data based on time series function resulted in somewhat higher values than estimations based on conventional linear function. The F-test for the cyclic function component of the marsh site was significant at the 0.01 level, demonstrating the existance of the cyclic component in the marsh zone system. (Carroll-FRC)
W82-01962

THE MODELING OF AQUATIC ECOLOGICAL SYSTEMS,
Akademiya Nauk URSR, Kiev. Inst. Kibernetiki.
A. G. Ivakhnenko.
Hydrobiological Journal, Vol 16, No 3, p 1-9, 1980. 4 Fig, 1 Tab, 25 Ref.

Descriptors: *Mathematical models, *Ecosystems, *Forecasting, *Water pollution sources, Planning, Mathematical studies, Statistical methods, Computers, Water quality, Lakes, Reservoirs, Lake Baikal, Dnieper reservoirs, USSR.

General properties of mathematical models of aquatic ecological systems are discussed, and modeling languages, typical input and output requirements, and problems with models are considered. Output variables that adequately describe the state of the object have to be selected. A support function and a structure for the mathematical model, such as order of derivatives, must be selected. Estimates of the parameters or coefficients of the model must also be obtained. A computer can be used to scan a large number of variables and determine which equations are most useful to the model. Long term forecasting and the optimization of the planning of water systems are two applications for aquatic system models. The uses of these techniques are illustrated by examples from Lake Baikal and the Dnieper chain reservoirs. (Small-FRC)
W82-01972

DREDGED MATERIAL EVALUATIONS: CORRELATIONS BETWEEN CHEMICAL AND BIOLOGICAL EVALUATION PROCEDURES,
For primary bibliographic entry see Field 5C.
W82-01985

SCALE-DEPENDENT DISPERSION IN A STRATIFIED GRANULAR AQUIFER,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 2F.
W82-01986

ACID RAIN AND ENVIRONMENTAL POLICY,
Thompson (Boyce) Inst., Ithaca, NY.
J. S. Jacobson.
Journal of the Air Pollution Control Association, Vol 31, No 10, p 1071-1073, October, 1981. 1 Tab, 14 Ref.

Descriptors: *Acid rain, *Decision making, Acidity, Rainfall, Cost-benefit analysis, Economic aspects.

Various seemingly paradoxical scientific questions are posed which relate to the problem of acid rain and its effect on the environment and environmental policy. The first paradox discussed concerns the supposed increase in fossil fuel usage over the last several decades, with the resultant increases in emissions of pollutants from the combustion of fuels which cause acid rain. Despite these increases, experts do not agree on whether acidity of rain has increased in eastern North America. The second paradox concerns the effect of acid rain on vegetation. If the rain is supposedly harmful, why have some reports shown increases and others, decreases in the growth of crops and trees with the application of simulated acid rain. The third paradox concerns the effect of acid rains on fish life in lakes. If acid rain falls throughout eastern North America, why have some lakes become acid and lost fish populations while others have not. Since unequivocal answers to these scientific questions are not available, a systematic approach is needed for developing policy which can be useful for solving the problem. It appears that traditional cost-benefit analysis can not be the sole basis for decision-making, but that it will be helpful. Research needs must be identified, and the upper and lower limits for alternative strategies must be determined. (Baker-FRC)
W82-01987

A NATIONAL SURVEY OF TRI(HALOALKYL)-, TRIALKYL-, AND TRIARYLPHOSPHATES IN CANADIAN DRINKING WATER,
Environmental Health Directorate, Ottawa (Ontario).
D. T. Williams, and G. L. LeBel.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 450-457, October, 1981. 3 Tab, 14 Ref.

Descriptors: *Potable water, *Organophosphorus compounds, *Canada, Phosphates, Rubber, Drinking water, Water pollution sources.

Twenty-nine municipalities across Canada were chosen for a survey regarding potable water contaminants. Samples of potable water were collected twice a year at the treatment plant of each municipality. Contaminants investigated included tri(haloalkyl)-, trialkyl- and triarylphosphates (TAP). A comparison of TAP levels with raw water sources indicated that higher TAP levels were found in potable water obtained from river sources as compared to lake sources. Groundwater sources in general gave very low TAP levels in the treated water. Of the drainage basins involved, St. Lawrence, Great Lakes, and Lake Winnipeg basins have higher levels of TAP compared to Atlantic Sea Board, Columbia, and Pacific Sea Board basins. The fraction of TAP values greater than 10 ng/liter was only 10% with the exception of tributoxyethyl phosphate, for which values were higher than 10 ng/liter. This compound is used in rubber gaskets such as those installed in plumbing, and high contaminant levels can result if water is left standing in water pipes. Studies are suggested to

locate the specific sources of TAP contamination. (Baker-FRC)
W82-01989

MATHEMATICAL MODELING OF STREAM WATER QUALITY BY A NEW MOMENT METHOD: FIELD INVESTIGATION OF A TIDAL RIVER,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 7B.
W82-01995

COMPARATIVE LIMNOLOGY OF INNER LONG POINT BAY, LAKE ERIE, AND ADJACENT WATERS OF THE OUTER BAY,
Ontario Ministry of Natural Resources, Wheatley. Lake Erie Fisheries Research Station.
J. H. Leach.
Journal of Great Lakes Research, Vol 7, No 2, p 123-129, 1981. 2 Fig, 3 Tab, 24 Ref.

Descriptors: *Limnology, *Lakes, *Water pollution effects, Aquatic productivity, Nutrients, Shallow water, Bays, Deep water, Alkalinity, Dissolved oxygen, Water properties, *Lake Erie, Long Point Bay.

Water quality and productivity were investigated in the Inner and Outer Long Point Bay, and current limnological conditions in the Inner Bay were compared with the results of a 1962 study. The Inner Bay is unique, as it has not been subjected to the pollutant loadings from point sources typical of most of the bay. The area east of the bay is currently undergoing industrial and urban development, and this study will provide benchmark data against which future studies of the environment can be compared. The Inner Bay, because of shallow depth and higher nutrient regimes, was more productive than the Outer Bay and had extensive macrophyte growths and higher chlorophyll alpha standing crops. All fourteen parameters studied were significantly different in the two bays except for nitrate, total alkalinity, and dissolved oxygen. The Inner Bay is eutrophic while the Outer Bay is mesotrophic. Changes in the Inner Bay since the 1962 study included increases in nitrate and nitrite and total alkalinity. (Small-FRC)
W82-02005

GEOLOGIC ASPECTS OF WASTE DISPOSAL SITE EVALUATIONS,
Law Engineering Testing Co., Marietta, GA.
For primary bibliographic entry see Field 5E.
W82-02011

ENVIRONMENTAL FATE OF METHYL EUGENOL,
Science and Education Administration, College Station, TX. Cotton Insects Research Lab.
T. N. Shaver, and D. L. Bull.
Bulletin of Environmental Contamination and Toxicology, Vol 24, No 4, p 619-626, 1980. 4 Fig, 1 Tab, 6 Ref.

Descriptors: Environmental effects, *Pesticides, Organic compounds, *Tomatoes, Soil analysis, Crop production, Agricultural chemicals, Water sampling, Chemical analysis, Leaching, Radioactive half-life, Bioaccumulation, Radioactive tracers, Radioisotopes, Carbon, Chromatography, *Methyl eugenol, *Fate of pollutants.

The fate of methyl eugenol in soil, water, and tomatoes is described. Methyl eugenol is a compound used as a synthetic lure in fruit fly control programs. Samples of radioactive and nonradioactive methyl eugenol were prepared and applied to soil, water and tomatoes. The half-life of methyl eugenol was measured in the samples, and samples were analyzed for the presence of eugenol. Results indicate that methyl eugenol dissipates rapidly from soil and water. About 98% of the material was lost within 96 hr at 32 degrees C. Leaching studies indicate that the compound is immobile in the soils tested, sand and loam. Only 3.8% of the applied dose of methyl eugenol was recovered after a 24 hr period from tomatoes treated topically. A small increase in unextractable radiocarbon was noted in the tomato pulp after 3 days. (Titus-FRC)
W82-02013

PARASITE OVA IN ANAEROBICALLY DIGESTED SLUDGE,
Cutter Lab., Shawnee, KS. Bayvet Div.
R. G. Arther, P. R. Fitzgerald, and J. C. Fox.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1334-1338, August, 1981. 3 Tab, 24 Ref.

Descriptors: *Parasite, *Eggs, *Sludge lagoons, Land application, Lagoons, Diseases, Public health, Pathogens, Sludge disposal, Water pollution sources, Fate of pollutants, Anaerobic digestion, Nematodes, *Chicago.

Lagooned anaerobically digested sludge samples from the Metropolitan Sanitary District of Greater Chicago were examined for viable parasitic ova on four dates during 1976 and 1977. Mean numbes of ova per 100 g dry lagooned sludge and the % capable of embryonation were as follows: Ascaris spp., 203, 24%; Toxocara spp. 173, 10%; Toxascaris leonina, 48, 43%; and Trichuris spp., 36, 6%. In fresh anaerobically digested sludge 20-64% of ova were capable of embryonation. The fact that ova of four genera of parasites survived anaerobic sludge digestion and lagooning shows that land application methods should be carefully evaluated. Conditions which favor development of parasites into transmissible forms are overhead spraying and surface irrigation. Subsurface injection and deep trench operation decrease the number and concentration of ova dispersed on the surface and reduce the oxygen available to the ova. However, subsurface application would also protect the ova from ultraviolet light and dehydration, which are unfavorable for embryonation. Sources of these parasitic ova are infected humans, pigs, dogs, and cats; they reach the sewer system from pasture runoff, slaugherhouses, street runoff, and animal shelter wastewater. (Cassar-FRC)
W82-02018

AQUATIC MICROBIOLOGY WITH REFERENCE TO TANNIN DEGRADATION,
Madras Univ. (India). Centre of Advanced Study in Botany.
A. Mahadevan, and G. Muthukumar.
Hydrobiologia, Vol 72, No 1/2, p 73-79, July, 1980. 3 Fig, 2 Tab, 42 Ref.

Descriptors: *Tannins, *Aquatic fungi, *Microbial degradation, Reviews, Degradation, Biodegradation, Fungi, Aquatic bacteria, Aquatic environment, Organic compounds, *Tannery wastes, Chemical properties, Microorganisms, Waste treatment, Microbiological studies, Water pollution sources, Fate of pollutants.

This review discusses tannin degradation in the aquatic environment. Tannins reach the rivers of India from many sources, notably tannery wastes. Plant tannins are amorphous, water soluble, polyhydroxy polyphenolic substances of molecular weights 500-3000, which form complexes with proteins and polymerize. Tannins are toxic to many microorganisms and inhibit microbial growth by suppressing respiration, nitrification, or enzyme action. The compounds may be degraded by some bacteria, yeast, and fungi, but vary in their susceptibility according to chemical form and particular organism. Microorganisms which can degrade tannins belong to the following species: Fusarium, Cylindrocarpon, Endothia, Achromobacter, Pseudomonas, Aspergillus, Penicillium and others. Degradation of tannins is greater in sugar-free media and with nitrogen sources such as sodium nitrate and ammonium sulfate. (Cassar-FRC)
W82-02028

PLANT BIOTESTS IN THE BIOINDICATION OF THE RAINFALL POLLUTION IN AN OIL REFINERY REGION,
Akademia Rolniczej, Warsaw (Poland). Inst. of Environmental Protection.
For primary bibliographic entry see Field 5C.
W82-02033

TERRAIN, GROUNDWATER AND SECONDARY SALINITY IN VICTORIA, AUSTRALIA,
Soil Conservation Authority of Victoria, Kew (Australia).
For primary bibliographic entry see Field 2F.
W82-02046

BROMIDE IN CANTERBURY GROUND WATER,
Department of Scientific and Industrial Research, Christchurch (New Zealand). Chemistry Div.
E. T. J. Bathurst, L. J. Thomson, and L. F. Wilkinson.
New Zealand Journal of Marine and Freshwater Research, Vol 14, No 4, p 409-411, 1980. 2 Fig, 3 Ref.

Descriptors: *Bromides, *Industrial wastes, Methyl bromide, Path of pollutants, Water pollution sources, *New Zealand, *Groundwater pollution.

Citizens living south and west of Christchurch, New Zealand, draw their water from unconfined aquifers, which are feared to be contaminated with methyl bromide industrial wastes. Analysis of 250 of the 600 wells in the area showed a bromide:chloride ratio which was constant and close to that of natural waters. Although a few wells had bromide levels as high as 0.2 mg per cu meter and high levels of dissolved ions, these higher concentrations were not widespread. It was concluded that the present bromide levels were no threat to health. (Cassar-FRC)
W82-02056

DEGREE OF POLLUTION OF SEVERAL MAJOR STREAMS ENTERING TOLO HARBOUR, HONG KONG,
Chinese Univ. of Hong Kong, Shatin. Dept. of Biology.
M-H. Wong, KC. Ho, and TT. Kwok.
Marine Pollution Bulletin, Vol 11, No 2, p 36-40, February, 1980. 2 Fig, 7 Tab, 16 Ref.

Descriptors: *Water pollution sources, *Industrial wastes, *Municipal wastes, River water, *Tolo Harbour, *Hong Kong, Land development, Marine environment, Marine sediments, Nitrogen, Phosphorus, Cadmium, Copper, Iron, Manganese, Lead, Zinc, Organic compounds, Path of pollutants.

Tolo Harbour is a land-locked sea in Hong Kong which has only a narrow outlet. Although untreated domestic and industrial wastes discharged into the harbor via several major streams are expected to be diluted and flushed away by tidal waves, decreasing volume of water in the harbor has led to low dilution of the wastes. Water and sediment samples from eight rivers were analyzed for total nitrogen content, total phosphate, cadmium, copper, iron, manganese, lead, and zinc. The sediment samples were also examined for total organic carbon. The pH of the water samples ranged from 6.0 to 8.1, with values falling between 6.8 and 7.8 for most rivers. Five of the rivers showed extremely low dissolved oxygen values, indicating that these rivers were bacteriologically active and contaminated by organic wastes. All of the water samples showed only trace amounts of phosphate. The high nutrient load in the sediments of two of the rivers indicates serious organic pollution. Water samples collected from seven of the eight rivers were found to contain one or more metal pollutants in concentrations exceeding the upper safety limits for drinking water. Sediments for five of the rivershad high levels of one or more heavy metals. Three rivers were found to be grossly polluted by both organic and inorganic contaminants. Strong legislation regarding the discharge of untreated wastes, careful planning of residential and industrial development, and a plan for final disposal of pig and poultry manure from agricultural areas are needed to prevent further deterioration of the harbor's environment. (Carroll-FRC)
W82-02058

THE DYNAMICS OF ANAEROBIC PHENOL BIODEGRADATION IN LOWER GREENLAND,

Harwell Lab., Oxon (England). Environmental and Medical Sciences Div.
J. F. Rees, and J. W. King.
Journal of Chemical Technology and Biotechnology, Vol 31, No 5, p 306-310, May, 1981. 2 Fig, 2 Tab, 12 Ref.

Descriptors: *Phenols, *Biodegradation, *Landfills, Leaching, Anaerobic digestion, Percolation, Simulation analysis, Waste disposal, Groundwater pollution, Mathematical equations.

The high solubility and poor adsorption of phenol by domestic refuse in a landfill environment can result in the leaching of phenol and pollution of groundwater. The most significant mechanism for reducing the concentration of phenol within the landfill and within an underlying porous rock formation may be anaerobic biodegradation. An artificial landfill leachate containing phenol was percolated through columns of disturbed Lower Greensand in an effort to establish the rates of anaerobic phenol degradation in a porous rock formation and to identify inhibitory concentrations of phenol and other factors affecting those rates. Phenol degradation was observed at concentrations up to 8.2 grams per cubic decimeter, but decomposition was increasingly inhibited above 3.0 grams per cubic decimeter. Maximum decomposition rates were observed at concentrations ranging from 1.5 to 3.0 grams per cubic decimeter. The maximum reaction velocity values at a flow of 0.5 cubic centimeters per hour was 1.05 grams per cubic decimeter per hour, and the Michaelis constant value was 450 milligrams phenol per cubic decimeter. The zero order rate constant and first-order rate constant increased with increasing flow rate. The data were used to develop equations for calculating the rates of phenol degradation in a real landfill. (Carroll-FRC)
W82-02071

USE OF KNOPP'S METHOD TO ASSESS SELF-PURIFICATION PROCESSES IN WATER BODIES AND WATER COURSES,
Byelorussia Univ., Minsk (USSR). Experimental Biological Special Topics Research Lab.
G. A. Inkina, and N. V. Dubko.
Hydrobiological Journal, Vol 16, No 3, p 69-73, 1980. 3 Tab, 12 Ref.

Descriptors: *Water analysis, *Self-purification, Water quality, Microorganisms, Oxidation, Fate of pollutants, Biotransformation, Lakes, Rivers, *USSR, Volga River.

Research was carried out in lakes of different types and in the Svisloch and Volga Rivers as moderately polluted water courses, in order to obtain comparative data by Knopp's method on the self-purification capacity of waters of different origin and to test the method under different conditions. Unfiltered and filtered water were used; oxygen content was determined in the control and experimental flasks, as were the abundance of microorganisms, the doubling time of the bacterial biomass, and the rate of cell respiration. The lakes contained water ranging from pure through eutrophic to highly eutrophic in character. It was concluded that the 6 hour duration suggested for the experiment by Knopp was too short for the lakes investigated. The relative heterotrophic activity of the bacteria was determined by the method of Godlewska-Lipowa for the water bodies and water courses investigated. According to current data the coefficient of heterotrophic activity (A/B) should increase as the pollution of water bodies and water courses increased. Use of the method revealed an inverse relation between the A/B coefficient and the extent of trophicity of the lakes in contrast to the positive correlation found by Godlewska-Lipowa in the Mazurian lakes in Poland. It was thus found in the application of the methods of Knopp and Godlewska-Lipowa to water bodies and water courses of various types and degrees of pollution that these methods do permit some assessment of potential capacity of the aquatic microflora to mineralize organic matter of the protein and carbohydrate type. However, further development is needed, and these methods cannot now be recommended as standard methods of water assessment. (Baker-FRC)
W82-02073

HYDROLOGIC AND ANTHROPOGENIC FACTORS AFFECTING WATER QUALITY IN THE RIVERS OF THE UKRAINIAN CARPATHIANS,
Akademiya Nauk URSR, Kiev. Inst. Hydrobiologii.
V. M. Shmakov.
Hydrobiological Journal, Vol 16, No 3, p 62-66, 1980. 1 Fig, 2 Tab, 4 Ref.

Descriptors: *Rivers, *Water quality, *Ukraine, *Water pollution sources, Hydrologic properties, Hydrologic aspects, Flow characteristics, Flow rates, Flow discharge, Hydrodynamics, USSR.

The Dniester, Danube and Visla basins contain the rivers of the Carpathian region of the Ukraine. The mean annual discharge of all the rivers of the region is about 15 cubic kilometers. Water consumption in the region is about 17% of the annual discharge. A large part of the wastewater discharged by the various areas of the economy is treated so as to upgrade it to established standards. A portion of the water is discharged without treatment. Basic hydrologic factors which affect the water quality of the Carpathian rivers include water content, flow rate, water temperature, the vegetation of the basin, the soils and subsoils of the basin, and the state of the water surface. An increase in the water content of rivers improves their capacity for dilution and self-purification and has a positive effect on water quality. The rivers of the southwestern slope of the Carpathians have the greatest water content. The water content of the rivers changes in the course of the year. A high water period occurs from March to August in the mountains, with the least discharge noted in winter and autumn. The Volhynian-Podolian region is typified by a spring flood, a summer low-water period, autumn floods and a winter low-water period. An increase in water temperature increases its dissolving power and content of dissolved salts. The concentration of pollutants in the river waters in the individual zones of the region differs in relation to hydrologic conditions, the siting of industrial enterprises, and population densities. The effect of the anthropogenic factor on river water quality in the region is felt up to an altitude of 400-500 meters and is increased at lower altitudes. (Baker-FRC)
W82-02076

BACTERIOPLANKTON AND PHYTOPLANKTON IN THE KIEV SECTOR OF KANEV RESERVOIR DURING THE PERIOD OF ITS FORMATION,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 2H.
W82-02081

STREAM POLLUTION IN HONG KONG - AN APPRAISAL,
Hong Kong Univ. Dept. of Botany.
I. J. Hodgkiss.
Environmental Conservation, Vol 8, No 2, p 119-125, Summer, 1981. 1 Fig, 4 Tab, 16 Ref.

Descriptors: *Natural streams, *Hong Kong, *Water pollution sources, Water quality, Water law, Water pollution prevention, Environmental protection.

Stream pollution in Hong Kong is discussed, with an outline of the history of stream pollution, data on the magnitude of the present problem, and future prospects. Many of the lowland streams are severely polluted, despite government attempts to control effluent discharges to streams. Ordinances were seldom enforced in the past, but new legislation is being passed which can be effective if enforced. Until a government policy toward existing industrial dischargers is established there will be little relief. Also, agricultural discharges must be treated. If domestic, industrial, and agricultural pollution sources are controlled, stream quality can be improved. (Small-FRC)
W82-02084

HYDROCARBON CONCENTRATIONS IN WATER AND SEDIMENTS FROM UK MARINE WATERS, DETERMINED BY FLUORESCENCE SPECTROSCOPY,
Ministry of Agriculture, Fisheries and Food, Burnham-on-Crouch (England). Fisheries Lab.
R. J. Law.
Marine Pollution Bulletin, Vol 12, No 5, p 153-157, May, 1981. 3 Fig, 4 Tab, 15 Ref.

Descriptors: *Oil pollution, *Hydrocarbons, *Water analysis, *Path of pollutants, Water pollution sources, English Channel, North Sea, *United Kingdom, Irish Sea, Estuaries, Sediments, Pollutant identification, Organic compounds, Spectroscopy.

Sediment and water at the 1 meter depth were sampled in the North Sea, English Channel, Irish Sea, and several estuaries along the United Kingdom coast, January 1978 to September 1979. Fluorescence spectroscopy revealed that the mean total hydrocarbon concentrations of water samples were (in micrograms per liter, using Ekofisk light crude oil as a standard): northern North Sea, 1.3; western Channel, 1.5; eastern Channel and southern North Sea, 2.5; and Irish Sea, 2.6. Estuarine and coastal samples were higher in hydrocarbons, up to 74 micrograms per liter at the main entrance to the River Mersey, a heavily industrialized area. Sediment total hydrocarbon levels were 0.27 to 340 micrograms per g dry weight, based on Ekofisk crude oil as a standard, the higher values occurring inshore. The highest total hydrocarbon concentration in offshore sediments was 120 micrograms per g at the Norfolk gas field. Water sampling 22 days after the wreck of the tanker, Amoco Cadiz, on the Brittany coast in early 1978 showed higher concentrations than in the following year. Concentrations of hydrocarbons were higher in fine sediments than in coarse sediments. (Cassar-FRC)
W82-02097

AMERICIUM IN INTERTIDAL SEDIMENTS FROM THE COASTAL ENVIRONS OF WINDSCALE,
Lancaster Univ., Bailrigg (England). Dept. of Environmental Sciences.
S. R. Aston, and D. A. Stanners.
Marine Pollution Bulletin, Vol 12, No 5, p 149-153, May, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Americium, *Radioisotopes, *Nuclear energy, Plutonium, Water analysis, Sediments, Intertidal areas, Windscale, *Ravenglass Estuary, Path of pollutants, England.

Americium activities ranged from < 3 pCi per g to 191 pCi per g in intertidal sediments collected along the open coast and embayments of northwest England. The study centered on Ravenglass Estuary, 10 km south of the Windscale nuclear fuel reprocessing plant. Greatest activities were found in the Ravenglass Estuary (River Esk, mean 69 pCi per g; River Irt, mean 60 pCi per g). These levels are 7 times higher than levels found in sediments 10 km from Windscale in the northeast Irish Sea (15-47 pCi per g). Study of a 10 meter x 10 meter area showed no correlation of americium activity with grain size of sediment. However, americium activities ranged from 46.9 to 195.8 pCi along a transect through salt marsh (mean activity 102.8 pCi per g), silt bank (mean 65.6 pCi per g) and channel section. Explanations for this enrichment in the marshes were: (1) only spring tides at high water cover this area, and (2) the rate of sediment accumulation is slow and may allow americium formation from plutonium in the surface sediments. (Cassar-FRC)
W82-02098

5C. Effects Of Pollution

ACID PRECIPITATION,
B. Hileman.
Environmental Science and Technology, Vol 15, No 10, p 1119-1124, October, 1981. 7 Fig.

Descriptors: *Water pollution effects, *Acid rain, *Air pollution effects, *Fishkill, Air pollution, Fallout, Drinking water, Water pollution, Precipi-

tation, Environmental effects, Aquatic life, Hydrogen ion concentration, Water pollution sources, Nitrogen compounds, Sulfuric acid, Runoff, Water pollution control.

When acid precipitation falls on areas that lack calcium carbonate, the acid is not neutralized and the runoff may acidify nearby lakes and streams killing fish and other aquatic organisms. Significant portions of Ontario, Quebec, and the eastern United States receive precipitation that is about 40 times more acidic than background values. Acid deposition into the atmosphere is caused mainly by emissions of SO2 and nitrogen oxides from the burning of fossil fuels. The sulfate ion also exchanges readily with calcium ions in soil leaving hydrogen ions behind to acidify the soil and water contained in a watershed. It has been difficult to assign a relative importance to man-made and natural sources as causative agents for acid precipitation. Acid waters tend to dissolved aluminum compounds, thus releasing aluminum ions which are very toxic to fish. Often in acidic lakes, filamentous algae and fungi proliferate. The loss of fish and many amphibians from acidified waters may affect populations of birds that feed on these organisms. Acid rain leaches many major minerals and trace metals from soils. It may also retard the decay of leaves slowing the rate of return of nutrients to the soil. Acid rain may cause drinking water supplies to become contaminated by heavy metals. Some emission control strategies and regulatory measures to control the problem are discussed. (Geiger-FRC)
W82-01607

AN ALTERNATIVE FOR MEETING THE NITRATE STANDARD FOR PUBLIC WATER SUPPLIES,
Harvard School of Public Health, Boston, MA. Dept. of Epidemiology.
G. F. Craun.
Journal of Environmental Health, Vol 44, No 1, p 20-25, August, 1981. 29 Ref.

Descriptors: *Drinking water, *Nitrates, *Water pollution effects, Potable water, Nitrites, Human diseases, Diseases, Public health, Epidemiology, Water pollution sources, Water treatment, *Methemoglobinemia, Infants.

In 1945, nitrate in drinking water was first associated with methemoglobinemia in infants. The development of the disease depends on the bacterial conversion of nitrate to nitrite before or after ingestion and occurs almost exclusively in infants less than 3 months old. Most reported cases have been associated with drinking water contaminated with more than 22 mg/liter nitrate-nitrogen. Some surface water supplies, primarily reservoirs, have been found to intermittently exceed the EPA limit on nitrate levels. Many individual wells in Illinois, Kansas, Missouri, Nebraska, Oklahoma, Texas, and Wisconsin have been reported to exceed 10 mg/l nitrate nitrogen, but EPA regulations do not apply to individual water systems. A survey of 8844 wells in Illinois showed that 27% of them exceeded 10 mg/l nitrate-nitrogen and in one county in Texas some wells exceeded 110 to 690 mg/l nitrate-nitrogen levels. Water high in nitrate can be blended with water low in nitrate to produce water that does not exceed the EPA limit, but this may not be technically or economically feasible in some areas. Although technology does exist to remove nitrate from water, the treatment is considered too sophisticated for smaller water systems, and costs for equipment, operation, maintenance, and disposal of the highly concentrated waste products from treatment are expensive. A program to warn parents to substitute an alternate source of water for infant feeding has been successfully instituted in the past in some areas where the nitrate levels have exceeded the limits. For example, in two California water systems that exceeded the limit, consumers received a printed warning on every water bill, and a further warning was sent to all new parents from the county health department. (Baker-FRC)
W82-01623

INCREASED TOXICITY OF AMMONIA TO RAINBOW TROUT (SALMO GAIRDNERI) RESULTING FROM REDUCED CONCENTRATIONS OF DISSOLVED OXYGEN,
Montana State Univ., Bozeman. Fisheries Bioassay Lab.
R. V. Thurston, G. R. Phillips, R. C. Russo, and S. M. Hinkins.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 983-988, August, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Ammonia, *Trout, *Dissolved oxygen, Water pollution effects, Fish, *Toxicity, Oxygen depletion, Nitrogen compounds, Rainbow trout.

Ammonia toxicity to rainbow trout (Salmo gairdneri) fingerlings increased as dissolved oxygen (D.O.) decreased over the test range 2.6-8.6 mg per liter. In 96-hour flow-through tests, some of the LC50 values (in mg NH3 per liter) ranged from 0.812 at 8.58 mg per liter D.O., to 0.316 at 2.64 mg per liter D.O. Fish were reared in water from a ground spring. Reduced D.O. concentrations were achieved by mixing this water with degassed water. The LC50 values were reached earlier at low D.O. concentrations than at high concentrations. Similar toxicity tests at 12, 24, 48, and 72 hours showed that the shorter the time period, the more pronounced the positive relationship between LC50 and D.O. concentration. This suggests that either individual fish requiring higher oxygen concentrations died early in the tests and/or the survivors became acclimatized to the ammonia. The recommended minimum D.O. concentration of 5.0 mg per liter (EPA, 1977) caused 30% less tolerance to ammonia than at 8.5 mg per liter D.O. Since any reduction below the highest tested (8.6 mg per liter) reduced tolerance of rainbow trout fingerlings to ammonia, it is recommended that water quality standards for D.O. consider the possible background levels of ammonia as well as the likelihood of temporary increases in those concentrations. (Cassar-FRC)
W82-01629

RELATIONSHIPS BETWEEN NANNOPLANKTON AND LAKE TROPHIC STATUS,
McGill Univ., Montreal (Quebec). Dept. of Biology.
S. Watson, and J. Kalff.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 960-967, August, 1981. 4 Fig, 3 Tab, 42 Ref.

Descriptors: *Trophic level, *Algae, *Nannoplankton, Plankton, Eutrophication, Water pollution effects, Lakes, *Lake Memphremagog, Biomass, Nutrients, Quebec-Vermont.

Analysis of data from Lake Memphremagog, which exhibits varying degrees of eutrophication, and published data from other lakes supported the hypotheses that as eutrophication increases (1) nannoplankton biomass increases and (2) the percentage of nannoplankton biomass decreases. This was true when trophic status was defined by total algal biomass. Seasonal means of total phosphorus, but not necessarily single measurements of total P, also correlated well with trophic status. However, the relationship of total P to hypothesis (2) was valid only in Lake Memphremagog, not in the other lakes. Net plankton had a less predictable relationship with total P than did nannoplankton. Empirical relationships to predict total nannoplankton from total algal biomass or total P were presented. (Cassar-FRC)
W82-01640

RELATING POPULATION GROWTH TO SHELLFISH BED CLOSURES: A CASE STUDY FROM NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Dept. of Sociology and Anthropology.
J. R. Maiolo, and P. Tschetter.
Coastal Zone Management Journal, Vol 9, No 1, p 1-18, 1981. 1 Fig, 2 Tab, 28 Ref.

Descriptors: *Water pollution effects, *Population dynamics, *Coastal zone management, Ecological effects, Economic impact, Environmental effects, *Shellfish, Population density, Coastal waters, Economic aspects, Shellfish farming, Cost-benefit analysis, Regression analysis, Impaired water quality, Case studies, *North Carolina.

During the 1970's legislation was passed showing local and national concern for regulating the development of coastal zones. Yet there remains a scarcity of data and methodologies for use in estimating the social and economic impacts of coastal development. In an empirical attempt to address this problem, data from two North Carolina coastal counties covering a 27-year period was analyzed. Over the time span examined, population growth in both counties was accompanied by increasing amounts of estuarine acreage closed to shellfishing due to decreased water quality along with decreased landings and exvessel values in the hard clam fishery. Specific estimates of landings and value losses per 1,000-person increase in the permanent population (as a proxy for total population) were developed by regression analysis. The economic and social consequences of coastal population growth are discussed. More research is needed on treatment of polluted waters, the cost-benefits of alternative growth patterns, and the effects on the coastal fish and shellfish markets and industry. (Geiger-FRC)
W82-01641

ACUTE TOXICITY OF INCREASED PH TO FRESHWATER SHRIMP PARATYA CURVIROSTRIS,
Auckland Regional Authority (New Zealand). Water Lab.
T. L. Shaw.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 91-93, 1981. 1 Fig, 1 Tab, 7 Ref.

Descriptors: *Hydrogen ion concentration, *Toxicity, *Shrimp, Water pollution effects, Alkaline water, Thermal powerplants, Industrial wastes, Rivers, *New Zealand, Waikato River, Freshwater shrimp.

The sensitivity of migrating freshwater shrimps to a range of pH values in the Waikato River was investigated. Migrating shrimps were trapped and exposed to pH values ranging from 7.47 through 10.66. Distributions of mortality in solutions in which death occurred were log-normal. There was no mortality in the control solution nor in those in which the initial pH was 9.50 or less. Localized increases in the pH of the river water to 9.71 would be detrimental to Paratya curvirostris populations. It is not known if the migration behavior of the shrimp would be changed or if migration would be disrupted. A thermal power station on the river has been granted a permit to discharge 8200 cu m of highly alkaline waste per day (up to 55 moles of hydroxide equivalent). The maximum concentration of hydroxide must not exceed 0.07 mM. Most of the plume should remain below pH 8.85. It is not known how these changes in the sublethal alkali concentrations will affect shrimp. (Small-FRC)
W82-01645

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS, 1968-73. I. THE EFFECTS OF EUTROPHICATION ON STANDING CROP AND COMPOSITION OF PHYTOPLANKTON,
Nebraska Univ., Lincoln. School of Life Sciences.
G. L. Hergenrader.
Hydrobiologia, Vol 71, No 1/2, p 61-82, May 27, 1980. 16 Fig, 6 Tab, 33 Ref. OWRT-A-067-NEB(1), 14-34-0001-1129.

Descriptors: *Eutrophication, *Phytoplankton, *Standing crops, Turbidity, Water pollution effects, Fertilizers, Agriculture, Nutrients, Chlorophyll a, *Salt Valley, *Nebraska, *Reservoir, Species distribution, Cyanophyta, Diatoms, Eutrophic lakes, Lakes.

The effects of eutrophication on standing crop and phytoplankton composition were investigated in four Salt Valley, Nebraska, flood control reservoirs during June, July, and August 1968-1973. These impoundments, constructed in 1961-1968, receive nutrient-rich runoff from land used for

intensive row crop agriculture. The oldest reservoir, Wagon Train, differed from the other three, Branched Oak, Pawnee, and Stagecoach, in its high inorganic turbidity, which controlled the production processes and affected the phytoplankton crop. Mean summer chlorophyll a concentrations in Wagon Train were usually in the range of 25-34 mg per cu meter, with a mean high in 1973 of 56.4 mg per cu meter. In the clear water reservoirs, chlorophyll a, phytoplankton number, and phytoplankton volume were correlated with reservoir age, the oldest having chlorophyll a concentrations up to 247 mg per cu meter and mean phytoplankton volumes up to 329 cu mm per liter, values in the hypertrophic class. The clear water reservoirs had 2-6 times higher chlorophyll a contents at the end of the study, the newest reservoir showing the greatest increase. Blue-green algae (Microcystis, Aphanizomenon, and Anabaena) quickly became dominant by the second year after construction. They comprised 80-95% of the total in most years. In Wagon Train, diatoms predominated in the early years of the study, 1968-1970. All lakes were considered eutrophic or hypereutrophic and are expected to remain so unless the agricultural practices change or the clear reservoirs develop turbidity. (Cassar-FRC)
W82-01653

PERIPHYTIC COMMUNITY RESPONSE TO CHRONIC NUTRIENT ENRICHMENT BY A RESERVOIR DISCHARGE,
Wyoming Univ., Laramie. Dept. of Zoology and Physiology.
M. D. Marcus.
Ecology, Vol 61, No 2, p 387-399, 1980. 7 Fig, 3 Tab, 65 Ref. OWRT-C-7054(6207)(3).

Descriptors: *Nutrients, *Diatoms, *Eutrophication, Nitrogen, Chlorophyll, Population dynamics, Algae, Plankton, *Reservoir releases, Downstream, Ecological effects, Streams.

This report describes periphytic development and growth in a stream below a montane reservoir with a deep-water release. The first study presented characterizes temporal and spatial periphytic growths and diatom populations on microscope slides at four stream sites below the reservoir. The second study examined increasing periphytic accumulations and diatom succession on two series of slides at a single site. Comparisons of the most upstream site with the three lower sites revealed that the discharges to Hyalite Creek stimulated periphytic productivity, increased periphytic proportions of chlorophyll a in the organic accumulations, and increased diatom species diversity and evenness. It was thought that ammonia nitrogen discharged from the reservoir was the primary factor influencing periphytic growth. Cocconeis placentula var. lineata generally dominated 70-80% of the diatom communities at the three downstream sites, whereas only three individuals of this species were noted at the upper site. Species other than Cocconeis appeared to have higher initial growth rates. Due to higher efficiencies for obtaining or incorporating limiting nitrogen resources, Cocconeis became the dominant species downstream. Species diversity at first increases and subsequently decreases as a function of resource abundance. (Baker-FRC)
W82-01658

EFFECT OF ALUMINUM SPECIATION ON FISH IN DILUTE ACIDIFIED WATERS,
Syracuse Univ., NY. Dept. of Civil Engineering.
C. T. Driscoll, Jr., J. P. Baker, J. J. Bisogni, Jr., and C. L. Schofield.
Nature (London), Vol 284, No 5752, p 161-164, March 13, 1980. 2 Fig, 1 Tab, 14 Ref. OWRT-A-073-NY(2).

Descriptors: *Acidic water, *Fish, *Aluminum, Sublethal effects, Water pollution effects, Acidity, Chemical properties, Toxicity, Hydrogen ion concentration, Speciation, Organic compounds, Fluorides, Sulfates, *Adirondack region, New York.

Water quality data were collected from several acidified lakes and streams in the Adirondack region of New York State in order to characterize aluminum chemistry in these waters and to assess the relative toxicity of various aluminum species to fish. Total aluminum levels increased dramatically with decreasing pH. Increased levels of labile aluminum, including free aluminum and aluminum fluoride, hydroxide, and sulfate complexes, accounted for most of the response to decreasing stream pH and increasing flow. Variations in organically chelated aluminum were found to be independent of hydrogen ion activity but significantly correlated with total organic carbon measurements. Aluminum complexes with dissolved organic ligands comprise the dominant fraction of aluminum in the waters studied, while fluoride complexes were the dominant inorganic aluminum species. Studies of the toxicity of various aluminum species to brook trout fry and to white sucker fry showed that complexation of aluminum with fluoride and/or with citrate significantly reduced the toxicity of aluminum solutions to these fry and that aluminum toxicity to fish is dependent on hydrogen ion activity. Aluminum toxicity to these fish decreased with decreasing pH. Fry survival rates in water treated with aluminum and complexed with fluoride and/or citrate were not significantly different from control solutions at equivalent pH values. Since organically complexed aluminum is the dominant form of aluminum species in these waters, it is suggested that measurements of total aluminum concentrations may result in substantial overestimations of potential toxicity. (Carroll-FRC)
W82-01663

THE EFFECTS OF CHLORINATED SEA WATER ON THE BLUE CRAB, CALLINECTES SAPIDUS,
College of William and Mary, Williamsburg, VA. Dept. of Marine Science.
C. E. Laird.
PhD Dissertation, 1980. 152 p, 39 Fig, 16 Tab, 100 Ref. University Microfilms International, Ann Arbor, MI; Order No GAX81-03589.

Descriptors: *Water pollution, *Toxicity, *Chlorination, *Crabs, Estuaries, Seawater, Mortality, Callinectes sapidus.

The effects of chlorinated sea water on the blue crab, Callinectes sapidus Rathbun, were evaluated through measurements of acute toxicity, serum constituents (protein, total ninhydrin positive substances, chloride, osmotic, sodium, potassium, calcium, and magnesium concentrations), oxygen consumption and ventilation rates in whole crabs, and oxygen consumption of excised gills. Histological examination of gills was also performed. The 96-hr LC50 for female blue crabs exposed to chlorinated sea water at 21 deg. C and 14 o/oo was 0.86 mgC12/1 C10 (chlorine induced osidants). The value for males under similar conditions was 0.84 mgC12/1 C10. Mortality was uncommon below 0.61 mgC12/1, but reached 100% with as little as 1.15 mgC12/1. Since magnesium regulation in the blue crab occurs at the bladder wall, the implication is that C10 acts on the crab at this internal site. This possibility compounds the already difficult problem of toxicant identification when using C10. (Sinha-OEIS)
W82-01679

PETROLEUM DEGRADATION BY NATURALLY OCCURRING POPULATIONS OF MARINE BACTERIA FROM MIDDLE ATLANTIC OUTER CONTINENTAL SHELF WATERS,
College of William and Mary, Williamsburg, VA. Dept. of Marine Science.
For primary bibliographic entry see Field 5G.
W82-01683

PHYTOPLANKTON PHOTOSYNTHESIS AND ITS RELATION TO STANDING CROP AND NUTRIENTS IN TWO WARM-MONOMICTIC SOUTH ISLAND LAKES,
Otago Univ., Dunedin (New Zealand). Dept. of Zoology.
For primary bibliographic entry see Field 2H.
W82-01700

EFFECTS OF ARTIFICIAL SHADING ON PERIPHYTON AND INVERTEBRATES IN A NEW ZEALAND STREAM,
Auckland Univ., (New Zealand). Dept. of Zoology.
D. R. Towns.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 2, p 185-192, 1981. 3 Fig, 1 Tab, 32 Ref.

Descriptors: *Algal growth, *Invertebrates, *Light penetration, Stream biota, Natural streams, Snails, Caddisflies, *New Zealand, Eutrophication, Periphyton, Aquatic plants, Comparison studies, Canopy, Sunlight.

The association between longterm periphyton cover and the abundance of invertebrates was investigated by artificially shading a small section of the Waitakere River prone to extensive periphyton growth. Invertebrates were sampled in shaded and unshaded areas. Beneath the canopy, the light intensity was 6% of that recorded in the unshaded area under overcast conditions. All visible attached periphyton disappeared in the shaded area, and total detritus dry weights were significantly lower. The snail, Potamopyrgus antipodarum, dominated the shaded area and was also abundant outside of the canopy. The hydropsychid caddisfly and the blackfly were more abundant under the canopy, but all chironomid species and rhyacophilid, hydroptilid, and conoesucid caddisflies were more abundant outside. The study indicates that the fauna associated with extensive algal cover make up three groups. The first comprises species directly associated with living algal material. The second includes species which feed on the inhabitants of algal cover and/or algal detrius but are excluded from areas of extreme cover through interference with attachment sites. The third is species which are most abundant in sections prone to long-term periphyton growths, but are not affected by the removal of living algae by shading. (Small-FRC)
W82-01701

ECOLOGICAL STUDIES OF PHYTOPLANKTON IN THE WAIKATO RIVER AND ITS CATCHMENT,
Auckland Univ., (New Zealand). Dept. of Botany.
C. W. Y. Lam.
New Zealand Journal of Marine and Freshwater Research, Vol 15, No 1, p 95-103, 1981. 6 Fig, 5 Tab, 24 Ref.

Descriptors: *Phytoplankton, *Nutrients, *Population density, Aquatic plants, Water analysis, Temperature effects, Rivers, Flow, Waikato River basin, *New Zealand, Eutrophication, Water pollution effects, *Ecological effects.

Sixty-nine genera (118 species) of phytoplankton were identified in the main streams and lakes of the Waikato River catchment. The study also included in situ readings of temperature, conductivity, and dissolved oxygen, and laboratory chemical analysis of water samples. The phytoplankton density increased downstream, reflecting the general enrichment of water from Lake Taupo to the river mouth. Changes in nutrient content that occurred between Lake Aratiatia and Lake Ohakuri were of major importance. The maximum and minimum of population density were controlled by seasonal changes of Melosira granulata var. angustissima. Temperature appeared to be an important factor controlling algal abundance. Flow rate also seemed important, but further research is needed to delineate the relative importance of flow conditions and temperature during the critical summer months. (Small-FRC)
W82-01704

ON THE USE OF CAROTENOID STRATIGRAPHY IN LAKE SEDIMENTS FOR DETECTING PAST DEVELOPMENTS OF PHYTOPLANKTON,
For primary bibliographic entry see Field 2H.
W82-01706

EFFECT OF THE COPPER CONTENT OF DISTILLERY SPENT WASH ON ITS UTILIZA-

TION FOR SINGLE-CELL PROTEIN PRODUCTION BY GEOTRICHUM CANDIDUM, HANSENULA ANOMALA AND CANDIDA KRUZEI,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
J. P. Quinn, T. W. Barker, and R. Marchant.
Journal of Applied Bacteriology, Vol 51, No 1, p 149-157, August, 1981. 5 Fig, 1 Tab, 21 Ref.

Descriptors: *Fermentation, *Copper, *Toxicity, Heavy metals, Yeasts, Fungi, Aquaculture, Biomass, Microorganisms, Industrial wastewater, Wastewater treatment, Water pollution effects, Chelation, Organic matter, *Whiskey distillery wastewater.

A fungus, Geotrichum candidum, and two yeasts, Hansenula anomala and Candida kruzei, obtained from Irish malt whiskey distillery spent wash, were grown in batch and continuous culture on samples of the spent wash, which contained copper at several concentrations ranging from 3.0 to 22.0 mg per liter. Maximum growth rates of G. candida were 0.294-0.337/hr at Cu concentrations of 3.0-11.5 mg per liter 0.255/hr at 17.5 mg Cu, per liter and 0.263/hr at 22.0 mg Cu per liter. This 20% reduction in growth rate at the highest Cu concentrations is less than expected because the high level of organic matter in the spent wash produces considerable complexing of the Cu, thus reducing toxicity. The biomass accumulated as much as six times the Cu present in the spent wash. In continuous culture with a mixed population of the three organisms, the biomass yields declined with increasing dilution rate and the cell Cu concentration increased, so that total Cu removed from the medium remained fairly constant. It is unlikely that the Cu levels normally found in spent wash (3-16 ppm) would inhibit the growth rate of these organisms. However, the Cu accumulated in the biomass is in excess of those recommended for animal diets. (Cassar-FRC)
W82-01750

IMPACTS OF NAVIGATIONAL DREDGING ON FISH AND WILDLIFE: A LITERATURE REVIEW,
Fish and Wildlife Service, Washington, DC. Office of Fishery Assistance.
For primary bibliographic entry see Field 6G.
W82-01768

ORGANIC SUBSTANCES IN WATER,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-01783

INFECTIOUS WATERBORNE DISEASES,
Geological Survey, Reston, VA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W82-01784

MICROBIOLOGY OF THE AQUATIC ENVIRONMENT,
Geological Survey, Reston, VA. Water Resources Div.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-E, 1981. 33 p, 15 Fig, 6 Tab, 27 Ref. (Greeson, P.E., editor).

Descriptors: *Water quality, *Microbiological studies, *Aquatic environment, *Aquatic life, Ecosystems, Lakes, Reservoirs, Detritus, Decomposing organic matter, *Water pollution effects, Stormwater, Bacteria, Chemical reactions, Iron compounds, Iron bacteria.

This is the fifth of several compilations of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, non-technical, easy-to-understand manner. The U.S. Geological Survey Circular contains papers on the microbiology of the aquatic environment. Briefing papers are included on 'The ecological role(s) of aquatic microorganisms in lakes and reservoirs', 'Effects of bacteria on the chemical and physical state of iron', and 'Microorganisms in stormwater: A summary of recent investigations'. (USGS)
W82-01786

BIOTA AND BIOLOGICAL PARAMETERS AS ENVIRONMENTAL INDICATORS,
Geological Survey, Reston, VA. Water Resources Div.
Available from the Branch of Dist., USGS, 604 S. Pickett St., Alexandria, VA 22304. Geological Survey Circular 848-B, 1981. 24 p, 4 Fig, 56 Ref. (Edited by Greeson, P.E.).

Descriptors: *Water quality, *Benthos, *Aquatic life, *Environmental effects, Species diversity, Algal growth, Biomass, Adenosine triphosphate, Lake classification.

This is the second of several compilations of briefing papers on water quality prepared by the U.S. Geological Survey. Each briefing paper is prepared in a simple, nontechnical, easy-to-understand manner. This U.S. Geological Survey Circular contains papers on selected biota and biological parameters as environmental indicators. Briefing papers are included on 'Species diversity and its measurement', 'Algal growth potential', 'Estimation of microbial biomass by measurement of adenosine triphosphate (ATP)', and 'Lake classification: Is there method to this madness.'. (USGS)
W82-01794

EUTROPHICATION OF THE SALT VALLEY RESERVOIRS 1968-73. III. THE MACROINVERTEBRATE COMMUNITY: ITS DEVELOPMENT, COMPOSITION, AND CHANGE IN RESPONSE TO EUTROPHICATION,
Nebraska Univ., Lincoln. School of Life Sciences.
G. L. Hergenrader, and D. C. Lessig.
Hydrobiologia, Vol 75, No 1, p 7-25, 1980. 10 Fig, 5 Tab, 65 Ref. OWRT-A-014-NEB(8).

Descriptors: *Reservoirs, *Macroinvertebrates, *Eutrophication, Water pollution effects, *Salt Valley, Nebraska, Invertebrates, Aquatic animals, Eutrophic lakes, *Nutrients, *Agricultural runoff, Midges, Oligochaetes, Clams, Hexagenia.

The macroinvertebrate communities in four Salt Valley, Nebraska, flood control reservoirs were studied during 1968-70. All the reservoirs are shallow and eutrophic, receiving nutrients from agricultural runoff. The most recently filled reservoir was least eutorphic, although the chlorophyll a standing crop was low in the oldest (Wagon Train), which was high in inorganic turbidity. In the newest reservoir, chironomids, oligochaetes, and fingernail clams were the early colonizers. Oligochaetes and fingernail clams decreased with increasing eutrophication. Hexagenia reached a maximum in the middle of the eutrophication continuum (Pawnee) and was absent from the most eutrophic reservoir (Stagecoach). Palpomyia increased with increasing eutrophication. Chaoborus was present in all reservoirs and did not show tendencies to increase or decrease with eutrophication. Chironomids were predominant in all reservoirs in the last year of the study. Standing crop was greatest in late fall-early winter and smallest during summer. (Cassar-FRC)
W82-01797

ESTUARINE DREDGE AND FILL ACTIVITIES: A REVIEW OF IMPACTS,
Florida State Dept. of Environmental Regulation, Tallahassee,
For primary bibliographic entry see Field 2L.
W82-01805

ACUTE TOXICITY OF AN IN SITU SHALE OIL PROCESS WASTEWATER AND IT'S MAJOR COMPONENTS TO DAPHNIA MAGNA,
Colorado State Univ., Fort Collins.
L. N. Burnham, W. W. Melvin, and R. M. Buchan.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 3, p 338-343, September, 1981. 2 Fig, 3 Tab, 11 Ref.

Descriptors: *Oil shale, *Toxicity, *Industrial wastewater, Shales, Microorganisms, *Daphnia, Crustaceans, Inorganic compounds, Industrial wastes, Wastewater, Water pollution effects.

The potential environmental hazard of an in situ shale oil process wastewater to aquatic organisms was investigated by determining the acute toxicity (48 hr) of this effluent to Daphnia magna. The effluent under study was obtained from the Laramie Energy Technology Center's experimental true in situ shale oil site near Rock Springs, Wyoming. A synthetic effluent was also prepared by mixing each of the major inorganic components identified in the real effluent at the concentrations found. The acute toxicity of this synthetic mixture was then compared with that of the original samples. Differences in the acute toxicities for the two test waters, the original sample and the synthetic effluent, were significant. The original effluent was 1.5 times as toxic as the synthetic mixture. Linearity was exhibited between log concentration and mortality for both the original effluent sample and the synthetic mixture. Regression lines were parallel, indicating similar modes of toxicity. In fact, the synthetic mixture appeared to exert its toxic effect as though it were a dilution of the original effluent. While these results indicate an important role for inorganics, particularly un-ionized ammonia, in the toxicity of the original effluent, the inorganics cannot be construed to be primarily responsible for the acute toxicity demonstrated against D. magna. It appears that not all the toxic components of the original effluent have as yet been identified. (Baker-FRC)
W82-01811

COMPARISON OF LIQUID-LIQUID EXTRACTION AND RESIN ADSORPTION FOR CONCENTRATING MUTAGENS IN AMES SALMONELLA/MICROSOME ASSAYS ON WATER,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5A.
W82-01812

EFFECT OF AN AERIAL APPLICATION OF CARBARYL ON BROOK TROUT (SALVELINUS FONTINALIS),
Maine Univ. at Orono. Dept. of Zoology and Columbia National Fisheries Research Lab., MO.
T. A. Haines.
Bulletin of Environmental Contamination and Toxicology, Vol 27, No 4, p 534-542, October, 1981. 4 Fig, 1 Tab, 14 Ref.

Descriptors: *Fish, *Pesticides, *Water pollution effects, Maine, Carbaryl, *Trout, Organic chemicals, Toxicity, Pesticide toxicity, Streams, Water pollution sources, Small watersheds.

Carbaryl was applied to two small forested watersheds at the rate of 0.5 lb active ingredient/acre in two applications spaced 7 days apart to determine the effect of this split application on brook trout mortality, condition factor, food, and brain AChE activity. The areas chosen were drained by two small streams located in northwestern Maine. Endemic brook trout predominated in the fish fauna of both streams. Mean fish brain AChE activity was significantly lowered (15 to 34%) in fish from the Little Russel Stream; slightly smaller reductions were found in fish from Logan Brook. The results of the in situ toxicity test indicated no mortalities associated with spray application. The AChE depression in fish of the Little Russel Stream dissappeared within 24 hr. The fish stomach contents, expressed as percent of body weight, did not change after the first spraying but did increase after the second. The increase in invertebrates in the stomachs after spraying resulted primarily from increased numbers of Ephmeroptera and Trichoptera, and to a lesser extent, Diptera. (Baker-FRC)
W82-01818

DETERMINATION OF MINERAL FIBER CONCENTRATIONS IN FISH TISSUES,
Environmental Research Lab.-Duluth, MN.
A. R. Batterman, and P. M. Cook.

Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 952-959, August, 1981. 3 Fig, 2 Tab, 15 Ref.

Descriptors: *Asbestos, *Fish, *Mineral industry, Fate of pollutants, Lake Superior, Pollutant identification, Fibers, Accumulation, Electron microscopy, Trout, Catfish, Arctic char, Anadromous fish.

Mineral fibers in fish tissue were determined by transmission electron microscopy examination after removal of water and organic matter by freeze-drying and low temperature ashing. Lake trout native to Lake Superior waters containing amphibole fibers from asbestos industry tailings had large numbers of chemically similar amphibole fibers in kidney tissue (up to 1428 fibers per mg), but only a few fibers in muscle (5 per mg) and liver (45 per mg). Only one amphibole fiber was found in all tissue samples from fish raised in the laboratory in amphibole-contaminated water. Lake trout from two locations with different fiber concentrations had corresponding differences in tissue fiber concentrations. The probable route for fiber accumulation in fish tissue is ingestion in food. The low levels of mineral fibers found in fish muscle tissue indicate that human consumption of fish from asbestos-contaminated waters is not of such great concern as asbestos-contaminated drinking water. (Cassar-FRC)
W82-01822

METHANOGENESIS IN FRESHWATER SEDIMENTS: INHERENT VARIABILITY AND EFFECTS OF ENVIRONMENTAL CONTAMINANTS,
Tennessee Univ., Knoxville. Dept. of Microbiology.
D. Pedersen, and G. S. Sayler.
Canadian Journal of Microbiology, Vol 27, No 2, p 198-205, February, 1981. 4 Fig, 5 Tab, 32 Ref.

Descriptors: *Methane bacteria, *Variability, *Sediments, Toxicity, *Water pollution effects, Lake sediments, Bacteria, Organic compounds, Polychlorinated biphenyls, Mercury, Phenanthrene, Polynuclear aromatic hydrocarbons, Paraquat, Herbicides, Coal liquefaction, Phenols, Melton Hill Reservoir, Tennessee.

The following aspects of methanogenesis in freshwater sediments were examined: temporal and spatial variability and effects of contaminants. At three sampling sites in the Melton Hill Reservoir, Tennessee, daily rates of methane production in the sediments varied substantially between replicates, among subsamples at a site, and among the three sites. Maximum rates occurred in August (24.4 plus or minus 24.6 to 764 plus or minus 75.6 nmol methane per g dry weight sediment) and minimum in January (0.3 plus or minus 0.5 to 22.2 plus or minus 4.4 nmol methane per g sediment). Statistical analysis showed that 20% of the variation in rates of methanogenesis could be attributed to the % of organic matter, 11% to pH, 6.6% to E sub h and the incubation temperature, and 3.7% to redox potential of the sediment. Neither number of methanogens nor depth of overlying water were significant in this respect. When toxicants were added to sediments, methanogenesis was inhibited at concentrations of 2570 mg per liter methyl viologen (paraquat), 100 mg per liter phenanthrene, and a 1:30 dilution of coal liquefaction waste effluent. No inhibition was seen after statistical analysis of test results from adding up to 10 mg per liter mercuric chloride or 10 mg per liter polychlorinated biphenyls. Effects of the toxicants were much slighter than expected, probably as a result of their interaction and inactivation with the sediments. (Cassar-FRC)
W82-01825

MERCURY METHYLATION BY FISH INTESTINAL CONTENTS,
Department of Fisheries and Oceans, Winnipeg (Manitoba). Freshwater Inst.
J. W. Rudd, A. Furutani, and M. A. Turner.
Applied and Environmental Microbiology, Vol 40, No 4, p 777-782, October, 1980. 2 Fig, 1 Tab, 27 Ref.

Descriptors: *Bioindicators, *Fish, *Mercury, *Methylation, Lakes, Radiometry, Bacteria, Water pollution effects, Canada, Ontario, *Wabigoon River basin.

Mercury methylation by fish intestinal contents was investigated as part of a larger project concerned with the severe mercury pollution problem of the Wabigoon River system of Northwestern Ontario. Fish were sampled from Clay Lake and Ball Lake, which are part of the Wabigoon River system, and from other nearby lakes which are not contaminated with mecury. Methylation occurred in the gut contents of fish obtained from five of the six lakes, and it occurred in all six species tested. Fish methylating activity was plotted against the total weight of intestinal contents, and something other than the quantity of food seemed to be influencing the rate of methylation. It may be the larger quantity of intestinal mucus found in the piscivorous species. Intestinal mucus is the site of the intense bacterial activity in other species and may be important here with respect to the contribution of intestinal mercury methylation to the concentration of mercury in the tissues. A radiochemical method was used which enabled the study of methylation in natural samples over short time periods. This method will be useful in the determination of mercury uptake routes. (Small-FRC)
W82-01830

NITRATES, CHLORATES AND TRIHALOMETHANES IN SWIMMING POOL WATER,
Florida International University, Miami. Drinking Water Quality Research Center.
For primary bibliographic entry see Field 5A.
W82-01835

EFFECTS OF SEDIMENTATION ON THE GRAVELS OF AN INDUSTRIAL RIVER SYSTEM,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
A. W. H. Turnpenny, and R. Williams.
Journal of Fish Biology, Vol 17, No 6, p 681-693, December, 1980. 6 Fig, 4 Tab, 26 Ref.

Descriptors: Dissolved oxygen, *Silting, *Fish populations, Gravel, Silt, *Coal mining, Industrial wastes, Rivers, *Mine wastes, Spawning, Fish eggs, Trout, Fish stocking, *Wales, *Ecological effects.

The effects of coal industry siltation on the natural recovery of trout populations in an industrial river were assessed in the Ebbw Fawr, South Wales. Fertilized rainbow trout eggs were planted in river gravels. Dissolved oxygen content of the water was determined, as was the apparent velocity of water flow through the gravels. Survival ranged from 91% in a control group to 0% at stations below the steelworks. Oxygen deprivation was responsible for high mortalities during incubation and the production of undersized fry. A progressive decline in dissolved oxygen was found in artificial redds due to siltation with resulting stagnation of intra-gravel water. The natural limiting factor may be the behavioral responses of spawning fish, as trout will not attempt to cut a redd when gravel permeability is low and where an appreciable downwelling is not detected by the fish. Fish stocking policies and the enhancement of natural recruitment by spawning channels may partially remedy the effects of many years' pollution of the rivers of the South Wales coal area. (Small-FRC)
W82-01881

ACUTE TOXICITIES OF THE HERBICIDES KOMEEN AND HYDROTHOL-191 TO GOLDEN SHINER (NOTEMIGONUS CRYSOLEUCAS),
California State Dept. of Fish and Game, Sacramento. Water Pollution Control Lab.
B. J. Finlayson.
Bulletin of Environmental Contamination and Toxicology, Vol 25, No 4, p 676-681, October, 1980. 2 Tab, 14 Ref.

Descriptors: *Fish, *Toxicity, *Herbicides, Pesticides, Aquatic weed control, Canals, Hardness, Chemical properties, Water pollution effects, Natural waters, Laboratory studies, Komeen, Hydrothol-191.

Studies were performed in American River water (soft) and a formulated hard water to determine the toxicity of the herbicides Komeen (Copperethylenediamine complex; 8% copper equivalent) and Hydrothol-191 (endothall) to fish. Komeen and Hydrothol-191 were suggested for controlling Hydrilla infestation in the All American Canal System (California). No previous continuous-flow toxicity tests on representative fish species had been conducted, nor had the effects of water quality on toxicity been investigated. Golden shiners were fasted for 48 hr, and acclimated to soft water for 2 wk or to hard water for 4 days prior to testing. Flow-through bioassays were conducted in 20 liter plexiglass tanks. Komeen 96-hr LC50 values were 630 ppm in hard water and 67 ppm in soft water. Hydrothol-191 120-hr LC50 values were 0.32 ppm in hard water and 1.6 ppm in soft water. It was concluded that of the two herbicides only Komeen can be used in this environment without extensive fish loss. (Carroll-FRC)
W82-01882

THE VALUE OF ECOLOGICAL MONITORING IN THE MANAGEMENT OF PETROLEUM INDUSTRY EFFLUENT DISCHARGES: EXPERIENCE IN ESSO PETROLEUM COMPANY U.K. REFINERIES,
Esso Petroleum Co. Ltd., London (England).
For primary bibliographic entry see Field 5G.
W82-01913

GENERALIZED COMPUTER SIMULATION MODEL FOR THE IMPACT ASSESSMENT OF INDUSTRIAL WATER USE ON FISH POPULATIONS,
Rensselaer Polytechnic Inst., Troy, NY. Dept. of Chemistry and Environmental Engineering.
C. Kleinstreuer, and B. E. Logan.
Water Science and Technology, Vol 13, No 7, p 363-390, 1981. 13 Fig, 1 Tab, 49 Ref.

Descriptors: *Fish populations, *Powerplants, *Industrial water, Cooling water, Water pollution effects, Impingement, Industrial wastes, Intakes, *Model studies, Computer models, Fisheries, Aquatic life, Oxygen, Dissolved oxygen, Fish harvest, Environmental effects, Entrainment.

The effects of man's activities on fish populations are simulated with a computer model. In the modeling framework, fish losses are regarded as sinks to the ecosystem. A lumped parameter approach is used. Components of the model are input data (environmental boundary conditions, plant operational conditions, and data on species concentration and fish life cycles), flow sub-models (ecosystem discretization and hydrodynamic factors), water quality submodels (temperature, dissolved oxygen, and pollutants), and a fish population model (age-structured fish population and net fish losses from natural or man-induced causes). This multi-species simulation is age-structured like a Leslie matrix and predicts oscillatory behavior like the Lotka-Volterra equation. A case study using far-field fish data from Lake Dardanelle and impingement data from Arkansas Nuclear One, Russelville, reveal that impingement dynamics are a reflection of the aquatic population dynamics. Estimates for gizzard shad and white crappie populations agreed well with actual data sets. The threadfin shad population dynamics were not as comparable, probably because the temperatures used were not representative enough. This model is also useful for evaluation of powerplant site alternatives and design and the impacts of industrial wastes, sudden dissolved oxygen depletions, and excessive fishing. (Cassar-FRC)
W82-01915

VARIANCE ESTIMATES FOR A DYNAMIC EUTROPHICATION MODEL OF SAGINAW BAY, LAKE HURON,

National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 2H.
W82-01917

TOXICANT ACCUMULATION IN HYDROBIONT TISSUES FOLLOWING EFFLUENT DISCHARGE,
Irkutskii Gosudarstvennyi Univ. (USSR). Biological and Geographical Research Inst.
Ya. M. Grushko, O. M. Kozhova, and L. M. Mamontova.
Hydrobiological Journal, Vol 16, No 3, p 55-58, 1980. 34 Ref.

Descriptors: *Bioaccumulation, *Effluents, *Fate of pollutants, Self-purification, Heavy metals, Cadmium, Mercury, Arsenic, Zinc, Lead, Cobalt, Copper, Naphthalene, Pyrene, Toxicity, Methyl antracene, Pyrelene, Benzanthrene, Organic compounds, *Fish, Plants, Hydrobiology, Literature review, Public health.

Data has been drawn from various literature sources concerning the accumulation of toxic substances in hydrobiont tissues after the fish and aquatic organisms were exposed to effluent discharge. Cadmium, chromium, copper, lead, nickel, zinc, and silver are accumulated in fish tissues from water polluted by industrial effluents. Mercury is accumulated from water by microorganisms and by the tissues of benthic organisms and fishes. An increase in the concentration of cadmium by comparison with the environmental concentration was noted in the liver, gills and muscle tissues of fishes. Hydrophytes and rice growing in water are polluted by cadmium and accumulate it. Arsenic and chromium were also shown to accumulate in fish tissues. Some organometallic compounds were also concentrated from water in the tissues of hydrobionts. The tissues of Daphnia accumulate methylmercury. Phenylmercuric acetate is concentrated from water by fishes, mollusks, various microorganisms and insects. Chlorinated biphenyls are concentrated by hydrobionts from water polluted by chemical industry effluents. Fish also concentrate the saturated hydrocarbons. Other organic toxicants such as insecticides and carcinogens are capable of biological accumulation in hydrobionts. The fact that many toxicants are accumulated by hydrobionts from the water of water bodies polluted by high concentrations of effluents must be taken into consideration when setting the maximum permissible concentrations of noxious substances in water bodies. The accumulation of toxicants by hydrobionts cannot be regarded as a factor in the self-purification of water bodies, as there is a risk that hydrobionts will die or that their fecundity will be reduced, and a high risk of poisoning to persons eating fish products exists. (Baker-FRC)
W82-01919

EFFECT OF SODIUM DODECYLSULFATE ON UNICELLULAR GREEN ALGAE OF THE GENUS CHLORELLA,
Akademiya Nauk URSR, Kiev. Inst. Botaniki.
L. I. Lenova, S. S. Stavskaya, and M. Ya. Ratushnaya.
Hydrobiological Journal, Vol 16, No 3, p 58-61, 1980. 5 Fig, 14 Ref.

Descriptors: *Surfactants, *Algae, Detergents, Dispersants, Soaps, Chlorella, Environmental effects, *Water pollution effects.

The effect of an individual anionic surfactant, sodium dodecylsulfate (SDS), on bacterially pure cultures of unicellular green algae of the genus Chlorella was investigated. Bacteria-free cultures of 3 intact and 23 mutant algal strains of Chlorella genus were used. In order to select strains capable of growing in the presence of surfactants, the algae under investigation were reared in agar nutrient media with SDS in various concentrations (1-200 mg/l). In the research in liquid media, the effect of the substance on the algae was assessed from the increase in biomass, counting the total number of Chlorella cells in a Goryayev chamber, and from the ratio of living to dead cells. The study showed that SDS in a concentration of 1-50 mg/l did not have an adverse effect on algal growth in rearing of C. vulgaris strains in the agarized nutrient medium. Inhibition of the growth of all the algal strains investigated, to different degrees, was noted in the presence of 100 mg/l SDS. The algae did not grow on solid media containing 200 mg/l of the surfactant. The mutant Chlorella strains behaved differently. Some inhibition of growth by comparison with controls was noted in the rearing of strains g-9, 14, 244, g-10, g-6, and 31 mut, reared on FDGA liquid medium to which surfactant was added. Microfloccules appeared in the experimental cultures of g-9, 14, g-10 and g-6, 31 mut on the fifth through sixth days, with their quantity increasing toward the end of the study. The content of dead cells increased appreciably, and cell detritus appeared. Marked inhibition of growth was noted for strains ty-0-19 and T5E12, which can be reared in the liquid nutrient medium with the surfactant. The data obtained indicate that the maximum dose of SDS that does not inhibit cell division in the algae investigated is 50 mg/l and, for only one strain, 200 mg/l. In no case was there a reduction in inhibition over time. (Baker-FRC)
W82-01920

BIOLOGICAL POLLUTION AND POLLUTION CONTROL IN CANALS DIVERTING FLOW FROM ONE RIVER BASIN TO ANOTHER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
O. P. Oksiyuk, and F. B. Stol'berg.
Hydrobiological Journal, Vol 16, No 4, p 1-6, 1980. 8 Ref.

Descriptors: *Canals, *Biomass, *Eutrophication, Water quality, Aquatic life, Aquatic plants, Phytoplankton, Benthos, Agricultural runoff, Industrial wastes, Self-purification, Water transfer, Diversion channels, Diatoms, Interbasin transfer, Water treatment, *USSR.

The balance between the processes of self-purification and biological pollution in canals is dependent on the abundance of algae, and also on those characteristics of artificial watercourses that affect their self-cleansing capacity. Water in canals originating from lowland rivers and from reservoirs created on them is especially subject to biological pollution. The bloom created by diatoms is one of the major sources of biological pollution in canals diverting flow from basin to basin. Filter plants that take water from the canal experience great difficulties every year at the time of profuse growth of diatoms. The amount of phytoplankton removed at the Upper Kal'mius filter plant reaches 10 to 50 t per day. Increased amounts of coagulants (2-2.5 times) are required for water purification. Polyacrylamide is added, and intensive rinsing of the filters is carried out frequently. Activated charcoal is also used, and chlorination procedures are modified. In contrast to phytoplankton, which is directly removed from the water at pumping stations, plant foulings, large quantities of which develop on the sides of lined canals, usually emerge as an indirect source of biological pollution that has an adverse effect on water quality due to the entry of decay products into the water. The stability of the substrate in canals creates conditions conducive to the formation of a large algal biomass on the slopes, as a result of which a large amount of organic matter accumulates, and the mineralization of this matter does not proceed sufficiently. The major means of controlling biological interference is preventing entry of biogenic matter via the effluents from industrial enterprises, built-up areas, and agricultural lands. (Baker-FRC)
W82-01922

THE HYDROFLORA OF URBAN PONDS AS AN INDEX OF THEIR SANITARY AND BIOLOGICAL STATE,
Kharkov Univ. (USSR).
For primary bibliographic entry see Field 2H.
W82-01924

BIODEGRADATION OF SODIUM ALKYLBENZENESULFONATE IN PLANKTON-CONTAINING POND WATER,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
For primary bibliographic entry see Field 5B.
W82-01925

OCCULT HEMOGLOBIN AS AN INDICATOR OF IMPINGEMENT STRESS IN FISHES,
New York State Dept. of Public Service, Albany. Office of Environmental Planning.
P. A. Isaacson, and N. J. Morrisson, III.
Progressive Fish Culturist, Vol 42, No 1, p 9, January, 1980. 1 Ref.

Descriptors: *Fish, *Fish barriers, *Powerplants, Cooling water, Fish behavior, Gills, Blood, Fish physiology, Entrainment, Stress analysis.

The use of occult hemoglobin in fish dermal mucus was assessed as an indicator of impingement stress. During the impingement process at cooling water intake sites, fish are subjected to various types of stress which can result in the death of fish. Fish collected from traveling screens at an operating power plant on the upper Hudson River were tested for stress using the hemoglobin released into the dermal mucus of the teleostean fishes as an indicator. Hemastix, a commercially available test strip, was used. The method was effective, but the test strips may be too sensitive, in that any stress including that of capture releases sufficient occult hemoglobin to give a maximum color reaction. (Small-FRC)
W82-01931

ZOOPLANKTON SPECIES DIVERSITY IN LAKE ST. CLAIR, ONTARIO, CANADA,
Windsor Univ. (Ontario). Dept. of Biology.
J. M. Winner, P. H. Patrick, and D. G. Wallen.
Hydrobiologia, Vol 75, No 1, p 57-63, October, 1980. 4 Fig, 4 Tab, 24 Ref.

Descriptors: *Lakes, *Zooplankton, *Species diversity, *Lake St. Clair, Ontario, Nutrients, Invertebrates, Water quality, Chlorophyll a, Nitrates, Phosphates, Silicates, Eutrophied lakes, Water pollution effects, Cladocerans, Copepods, Rotifers, Thames River, Primary productivity, Productivity, Urban runoff, Agricultural runoff.

Zooplankton species diversity, chlorophyll a, and water quality were studied in Lake St. Clair, Ontario, during the summer of 1971. The lake receives urban and agricultural runoff. As determined by weekly sampling at three sites the chemical parameters of the water were as follows (in g per liter): chlorophyll a, 0.02-8.65; particulate C, 25.5-270; nitrate, 2.0-55.9; total P, 0-0.033; and reactive silicate, 121-4990. Stations 1 and 2, enriched by Thames River drainage, had the highest primary productivity and zooplankton species diversity. There was no significant correlation between total zooplankton diversity and chlorophyll a. However, chlorophyll a, reactive silicate and nitrate correlated positively with cladocerans and copepods at stations 2 and 3. Rotifers were negatively correlated with chlorophyll a, nitrate, and reactive silicate. The results indicate that cladocerans, copepods, and rotifers occupy different ecological niches, and that in nutrient-rich lakes, factors other than food are limiting. (Cassar-FRC)
W82-01937

EFFECTS OF THE AQUATIC HERBICIDE 2,4-D DMA ON THE ECOLOGY OF EXPERIMENTAL PONDS,
Columbia National Fishery Research Lab., MO.
T. P. Boyle.
Environmental Pollution (Series A), Vol 21, No 1, p 35-49, January, 1980. 2 Fig, 6 Tab, 27 Ref.

Descriptors: *Aquatic life, *Herbicides, *Growth, Water pollution effects, Fish, Bluegills, Phytoplankton, Algae, Chlorophyll a, Nutrients, Macrophytes, Ecological effects, Invertebrates, Zooplankton, Aquatic weed control.

In experimental ponds the dimethylamine salt of 2,4-dichlorophenoxyacetic acid (2,4-D DMA) stimulated growth of rooted macrophytes at the 5 kg per ha application rate and stimulated photosyn-

thetic uptake of C14 in natural phytoplankton communities at concentrations of 2 mg per liter. Bluegill condition factors and growth were improved at the 10 kg per ha dose. Weights of fish were 16 g vs. 10.6 g in controls, and lengths were 9.4 cm vs. 8.4 cm in controls. Initial concentrations of 0.90 mg per liter (10 kg per ha dose) and 0.35 mg per liter (5 kg per ha dose) peaked at 7 days (1.2 and 0.60 mg per liter, respectively) and both declined to the non-detectable level of 0.1 mg per liter by 56 days. Statistical analysis of covariance by path analysis revealed that gross production in 2,4-D DMA treated ponds was related to planktonic chlorophyll a and dissolved nutrients. It was believed that nutrients leaked from plants into water and stimulated phytoplankton growth. (Cassar-FRC)
W82-01949

ECOLOGICAL AND PHYSIOLOGICAL CHARACTERISTICS OF DIKEROGAMMARUS HAEMOBAPHES IN THE AREAS IN WHICH HEATED WATER IS DISCHARGED FROM THE TRIPOL'YE POWER STATION,
Akademiya Nauk URSR, Kiev. Inst. Hidrologii.
L. A. Kititsyna.
Hydrobiological Journal, Vol 16, No 4, p 61-68, 1980. 4 Fig, 3 Tab, 19 Ref.

Descriptors: *Zooplankton, *Cooling water, *Heated water, Power plants, Thermal pollution, *Environmental effects, Fish food, Water pollution effects, Gammarids, Food chains, Tripol'ye power station, USSR.

The response of Dikerogammarus haemobaphes to the heated water of Knaev reservoir was determined during the three years of reservoir construction. In the area around the district power station certain changes occurred in the species composition of the benthos. As the water became warmer, Chaetogammarus ishnus and Pontogammarus were no longer dominant, but Dikerogammarus was. Samples were collected by dredge and bottom-grab, and the calorific value of the gammarids, their metabolic rate, and other indices were determined. Dikerogammarus haemobaphes had adapted well to the heated waters in the reservoir and withstood a wide range of water temperatures. They can be introduced into other cooling facilities to provide fish food. (Small-FRC)
W82-01970

A PRELIMINARY STUDY OF THE EFFECT OF PUMPED-STORAGE PLANT OPERATION ON ZOOPLANKTON,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
Ya. Ya. Tseyeb, and G. A. Zhdanova.
Hydrobiological Journal, Vol 16, No 4, p 31-35, 1980. 2 Tab, 8 Ref.

Descriptors: *Zooplankton, *Hydroelectric plants, Powerplants, Plankton, Aquatic life, *Reservoirs, Entrainment, Hydroelectric power, Electric power production, *Kiev reservoirs, USSR, Ecological effects.

The effect of pumping water from the Kiev reservoirs on the qualitative and quantitative composition of the zooplankton in the pumped-storage facility was investigated. Attempts were also made to assess the general effect of the Kiev pumped-storage plant on the zooplankton of Kiev Reservoir. When the species and quantitative composition of the zooplankton of Kiev reservoir in the area of the water intake were compared it was noted that the upward pumping of water had a lethal effect on zooplankton. There were far fewer zooplankton species in the upper pumped-storage facility than in the reservoir, with the total number of species being reduced from 20 to 9 in the spring, and from 37 to 24 in the summer and autumn. The species which disappeared were those whose biomass was least, primarily Rotatoria. Among the crustaceans such large forms as Daphnia cucullata, D. hyalina, Leptodora kindtii and Eurytemora velox perished. The mortality of zooplankton in the downward release of the water was calculated on the basis that the figures would be equivalent to those obtained in the pumping regime of the pumped-storage station. It was established that about 1% of the initial zooplankton biomass would survive in the course of a day in the area of the water intake in the spring as a result of the successive effect of the pumping and turbine regimes of the pumped-storage plant. While the adverse effect of the Kiev pumped-storage hydroelectric plant is manifested in the almost total death of the zooplankton entering its sphere, it is ultimately very weak and cannot appreciably affect the food resources of fishes consuming zooplankton. (Baker-FRC)
W82-01971

DREDGED MATERIAL EVALUATIONS: CORRELATIONS BETWEEN CHEMICAL AND BIOLOGICAL EVALUATION PROCEDURES,
R. A. Laskowski-Hoke, and B. L. Prater.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1260-1262, July, 1981. 1 Fig, 2 Tab, 16 Ref.

Descriptors: *Dredging, *Sediments, *Benthic fauna, Pollutant identification, Water pollution effects, Bioindicators, Bioassay, *Lake Michigan, Lake sediments, Chemical analysis, Ecological effects, Invertebrates, *Spoil disposal, Evalution.

A bulk sediment-chemistry evaluation procedure (EPA Regions V and IX) and an elutriate test (U.S. Army Corps of Engineers) were compared with a bioassay technique as a means of evaluating disposal methods for dredged material. Forty sediment samples collected in 1977 from Lake Michigan were analyzed. The elutriate process required analysis of ammonia, COD, total P, total Kjeldahl N, nitrate, nitrite, chloride, sulfate, and 8 heavy metals. The sediment-chemistry technique relied on analysis of total Kjeldahl N, total P, COD, sieve size, oil, grease, cyanide, and 11 metals. Test organisms for the bioassay were Pimephales promelas Rafinesque, Hexagenia limbata Walsh, Lirceus fontinalis Rafinesque, and Daphnia magna Straus. Statistical analysis of results indicated that a combination of bulk sediment-chemistry and sediment bioassays would be the most efficient and ecologically sound approach to evaluating the effects of dredged materials on benthic communities. (Cassar-FRC)
W82-01985

A NEW METHOD FOR ASSESSING THE LETHAL IMPACT OF SHORT-TERM, HIGH-LEVEL DISCHARGES OF POLLUTANTS ON AQUATIC ANIMALS,
Sunderland Polytechnic (England). Dept. of Biology.
P. D. Abel.
Water Science and Technology, Vol 13, No 7, p 347-352, 1981. 5 Fig, 1 Tab, 3 Ref.

Descriptors: *Water pollution effects, *Aquatic animals, *Copper, *Pesticides, *Toxicity, *Lindane, Insecticides, Chlorinated hydrocarbons, Mortality, Lethal limit, Poisons, Pesticide toxicity.

The effects of the organochlorine pesticide, lindane, and of copper on Gammarus pulex were investigated by a new method designed to evaluate the lethal impact on aquatic animals of brief exposure to high concentrations of water pollutants. Results demonstrated that animal mortality due to a brief exposure to high levels of a poison may continue for up to 3 weeks after the initial exposure. Combinations of exposure time and poison concentration which result in appreciable mortality were sometimes lower than continuous exposure mortality values of conventional toxicity test systems. The present method is considered more useful than conventional toxicity test procedures in predicting the outcome of water pollution incidents involving the brief discharge of high levels of pollutants. (Geiger-FRC)
W82-01993

TEMPERATURE TOLERANCE AND THE FINAL PREFERENDUM - RAPID METHODS FOR THE ASSESSMENT OF OPTIMUM GROWTH TEMPERATURES,
Tromso Univ. (Norway). Inst. for Fiskerifag.
M. Jobling.
Journal of Fish Biology, Vol 19, No 4, p 439-455, October, 1981. 2 Fig, 2 Tab, 138 Ref.

Descriptors: *Heated water, *Fish, Water pollution effects, Thermal pollution, Thermal water, Powerplants, Cooling water, Industrial water, Thermal stress, Growth, *Ecological effects, Literature review.

Correlations were sought between the preferred temperature, temperature tolerance, and optimum growth for some species of fish. Values for growth optima, final preferenda and temperature tolerance were extracted from the published literature, and correlations were drawn between these indicators of thermal requirements. These values are listed in a table by species. Linear regression analyses were used to show relationships among temperature requirements of fishes. The analysis of the data suggested that the final preference gives a good indication of the optimum temperature for growth. Thus the determination of the preferenda could be used as a rapid method for estimating the temperature required to promote maximum growth of fishes. A good correlation was also found between lethal temperature and optimum temperature for growth. Such information is valuable in determining possible ill effects on fish from the discharge of cooling water from power generating stations, with the resultant addition of waste heat to natural waters. (Baker-FRC)
W82-01996

DYNAMICS OF CARP GROWTH AND BIOSYNTHETIC PROCESSES IN THE LIVER OF THE CARP REARED IN CONTAINERS IN HEATED WASTE WATER FROM THEMAL POWER STATIONS,
Akademiya Nauk URSR, Kiev. Inst. Hidrobiologii.
N. Yu. Yevtushenko, and V. D. Romanenko.
Hydrobiological Journal, Vol 16, No 4, p 58-61, 1980. 1 Fig, 7 Ref.

Descriptors: *Heated water, *Fish, Growth, *Carp, Thermal stress, Temperature effects, *Water pollution effects, Thermal powerplants, Powerplants, Thermal power, Cooling water, *Thermal pollution.

Carp were raised in containers in heated wastewater from thermal power stations to determine the effect of the heated water on the growth of the fish. The study revealed uneven accumulation of body biomass at different stages in the vegetation period in the rearing of the carp. A definite relationship was established between the growth rate of the carp and its initial mass. The relative mass increment of the body of carp of different initial mass during the first month of such rearing was slightly retarded in comparison with the following months of rearing. At the same time, the difference in the relative increments of carp of the different weight groups in the initial period of container rearing was not significant. A sharp increase in the growth rate of the carp in the containers was noted in July. The relative increase in the body mass of the first group of fish was 121.2% relative to the previous month, while in the second experimental group it had increased over this period by 160.3%. The rate of biosynthetic processes in the liver was relatively high during the initial period of rearing, one month after the stocking of the containers. Beginning in the second half of August, the rate of uptake of radiocarbon into organic compounds extractable from the liver of carp caught in August declined by comparison with the previous month by 22.1%. An even lower rate of uptake of the radioactivity was noted in autumn. The data revealed a higher growth rate of the carp in container rearing in warm water in July through August. The relative increment in the body mass of the fish declined sharply in the second half of August, in spite of the fact that the water temperature in the water used for cooling purposes remained fairly high at that time. (Baker-FRC)
W82-01998

PARASITE OVA IN ANAEROBICALLY DIGESTED SLUDGE,

Cutter Lab., Shawnee, KS. Bayvet Div.
For primary bibliographic entry see Field 5B.
W82-02018

EFFECT OF DIFFERENT WATER SALINITY LEVELS AND ORGANIC MATTER APPLICATION ON THE COMPOSITION OF WATER SOLUBLE AND EXCHANGEABLE BASES IN A BRACKISHWATER FISH POND SOIL,
Central Inland Fisheries Research Inst., Barrackpore (India).
For primary bibliographic entry see Field 2H.
W82-02027

PLANT BIOTESTS IN THE BIOINDICATION OF THE RAINFALL POLLUTION IN AN OIL REFINERY REGION,
Akademia Rolniczej, Warsaw (Poland). Inst. of Environmental Protection.
D. Zukowska-Wieszczek, and H. Zimny.
Plant and Soil, Vol 55, No 2, p 321-325, 1980. 4 Tab, 5 Ref.

Descriptors: *Rainwater, *Chemical composition, *Water pollution sources, *Acid rain, Chemical analysis, Acidity, Heavy metals, Sulfates, Nitrates, Industrial wastes, Plant growth, Cucumbers, Beans, Beetrouts, Water pollution effects, Bioindicators, Environmental effects, Oil industry, Europe.

Rainfall was collected during spring and summer at four points localized in the vicinity of the largest oil refinery in Europe. The rain water was analyzed chemically by atomic absorption spectroscopy. Sulfur was estimated by nephelometric methods, chlorine was measured argentometrically and pH, electrometrically. Beans, beetroot and cucumber were grown in the rainwater. Rainwater collected near the industrial and oil refinery regions had a pH value ranging from 2.4 to 4.4. Chemical analysis showed that the water was high in minerals and pollution by heavy metal ions as well as having increased acidity due to sulfates, nitrates and nitrites. The germination capacity of seeds treated with rain water from the refinery region was significantly decreased in comparison to those germinating on distilled water. Impairment of seed germination capacity was higher for seeds germinating on water from the summer than from the spring rainfalls. Seedling growth, while vigorous at first, soon showed signs of shortening and thickening of the hypocotyl and maceration of root-cap. Beetroot showed the most significant changes. (Baker-FRC)
W82-02033

MICROBIAL POLLUTION OF COASTS AND ESTUARIES: THE PUBLIC HEALTH IMPLICATIONS,
PHLS Centre for Applied Microbiology and Research, Porton Down, Wiltshire (England). Reference Laboratory for Environmental Hygiene.
G. I. Barrow.
Water Pollution Control, Vol 80, No 2, p 221-230, 1981. 15 Ref.

Descriptors: *Estuaries, *Pollution load, *Public health, Microorganisms, Coasts, *Effluents, Estuarine environment, Shellfish, Recreation, Water use, Swimming, *Great Britain.

Potential microbial health hazards and their relation to sewage pollution of estuaries and coastal waters in Britain are considered. The risks essentially concern the possibility of infection from bathing and from the consumption of molluscan shellfish. Rivers have traditionally been used to carry domestic sewage and industrial effluents. Even efficient sewage treatment does not remove all bacteria and other micro-organisms. The presence of any microbial pathogens in coastal waters presents potential health risks. There is no absolute relationship between the presence of a pathogen and the risks of contracting the associated disease, even in susceptible persons, and each case must be considered on its merits. Basic knowledge of the reservoir of a pathogen, its origin, mode of spread, route of infection, and the degree of susceptibility of the community or individual are all factors which need to be examined. No significant evidence has been gained linking the degree of sewage contamination of coastal or other waters with defined diseases. No public health evidence exists in the United Kingdom to suggest that either bathing or the consumption of shellfish should be prohibited solely due to non-compliance with any of the microbiological parameters specified in the EEC directives. (Baker-FRC)
W82-02051

THE EFFECTS OF MINE DRAINAGE AND ORGANIC ENRICHMENT ON BENTHOS IN THE RIVER NENT SYSTEM, NORTHERN PENNINES,
Freshwater Biological Association, Wareham (England). River Lab.
P. D. Armitage.
Hydrobiologia, Vol 74, No 2, p 119-128, September, 1980. 5 Fig, 5 Tab, 14 Ref.

Descriptors: *Zinc, *Benthic fauna, *Mine drainage, *Water pollution effects, Heavy metals, Rivers, Streams, *Nent River, Algal growth, Nutrients, Aquatic animals, Mine wastes, Acid mine drainage, Organic wastes, *England.

Lead mining in the River Nent system, northern England, reached its peak in the 18th century. Except for brief operation of a flotation plant in 1942-43, there has been no mining activity there since 1921. This paper reports the impact on the benthic fauna of zinc and other heavy metals, acid mine drainage, and organic enrichment from agricultural and domestic sources. Sites were divided into three zinc areas (low, 0.01-0.36 mg per liter; medium, 0.77-1.68 mg per liter; and high, 2.08-7.60 mg per liter) and one acid site. Zn levels were negatively correlated with numbers of taxa. At mainstream sites with Zn levels of 0.7-1.7 mg per liter massive growths of the Zn- and pollution-resistance alga Stigeoclonium tenue were associated with low faunal abundance. Chandler biotic scores showed a downward trend from the river's source to the junction with the River Tyne. No sign of improvement in the water quality was seen 8 km downstream of the major Zn input. Relationships between the acid water section, the Ca concentrations, and the Zn levels with respect to toxicity are discussed. (Cassar-FRC)
W82-02053

EFFECTS OF POLLUTION UPON THE BENTHOS OF BELFAST LOUGH,
Northern Ireland Department of Agriculture, Coleraine, Fisheries Research Laboratory.
J. G. Parker.
Marine Pollution Bulletin, Vol 11, No 3, p 80-83, March, 1980. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Benthos, *Water pollution effects, *Belfast Lough, *Northern Ireland, Benthic fauna, Salinity, Temperature effects, Bays, Path of pollutants, Harbors.

Belfast Lough, a bay lying between the North Channel and the mouth of the River Lagan, is the receiving water for the domestic and industrial wastewater from the city iof Belfast and other towns surrounding the lough. Benthic studies are being conducted to determine the effects of pollution on the spatial pattern of benthic life in the bay. Samples obtained from 41 sites resulted in the collection of about 40,000 specimens of benthic fauna. Three of the sampling sites in the harbor area yielded no benthic macrofauna. Sites within the docks area which did support benthic fauna were dominated by Oligochaeta, followed by polychaetes. The distribution of polychaetes, which dominated the fauna of 19 of the sampling sites, showed a significant positive correlation with graphic kurtosis, but not with any other environmental factor. The distribution of Oligochaeta, which were next in order of abundance and dominated 11 sampling sites, was not significantly associated with salinity, but did decrease significantly with distance from Belfast, with depth, and with surface temperature. The distribution of Isopoda, which were third in order of abundance, was not significantly associated with any of the physical or chemical parameters investigated. Amphipods, which dominated six ampling sites although they were slightly less abundant than isopods, were the only species significantly correlated with salinity. The results of this study indicate that benthic fauna in the harbor area suffers from the gross effects of pollution, while fauna in the outer lough is subjected to diffusely distributed pollutants. (Carroll-FRC)
W82-02059

SEASONAL VARIATIONS IN THE ACTUAL FECUNDITY OF DAPHNIA MAGNA IN A LABORATORY CULTURE,
Moscow State Univ. (USSR).
Ye. F. Isakova.
Hydrobiological Journal, Vol 16, No 4, p 69-71, 1980. 1 Fig, 11 Ref.

Descriptors: *Daphnia, *Cultures, *Water pollution effects, Rivers, *Moscow River, Productivity, Crustaceans, Floods, Runoff, Growth, Population dynamics, Seasonal variation, USSR.

The object of this study was to determine changes in the survival rate and fecundity of Daphnia cultivated in water from the Moscow River in different seasons. Seventy-eight consecutive generations of the parthenogenetically reproducing crustacean D. magna were investigated. Twice during the study near 100% mortalities of the Daphnia were recorded. The first occurrence was in March 1974, when water was taken from the river during the spring flood. The second time water had a lethal effect on Daphnia occurred between the middle of July and September of 1975. The summer of 1975 was one of frequent thunder storms and torrential rain. Hydrochemical analysis of the river water at this period showed that the total biological oxygen demand (BOD) was double the normal level. Ammonium content was also doubled, which indicated organic pollution of the water. It is probable that runoff from the fields and atmospheric precipitation had a lethal effect on the hydrobionts. Several alternating periods of raised or lowered fecundity were noted during the study. Seasonal variations in the abundance of plankton crustaceans are due under natural conditions both to changes in environmental factors and to interactions within an between populations. The findings allowed the conclusion that the fluctuations in the indices of the survival of Daphnia in water from the Moscow River are not governed by seasonal factors, but are dependent on the quality of the water, in particular on its content of toxic ingredients. A periodic reduction in fecundity was noted in the winter and in the summer months. (Baker-FRC)
W82-02083

WANTED: WATER FOR DEVELOPMENT,
For primary bibliographic entry see Field 6D.
W82-02088

WATER QUALITY MANAGEMENT OF LAKE NEUSIEDLER, AUSTRIA,
Federal Inst. on Water Resources Research (Switzerland).
H. Fleckseder.
Aqua, No 5, p 3-7, 1981. 1 Fig, 9 Ref.

Descriptors: *Water quality, *Eutrophication, Phosphorus, Water management, Water quality management, Water quality control, *Lake Neusiedler, *Austria, Water treatment facilities.

Lake Neusiedler, Austria, is extremely shallow, with an average depth of some 2 meters. During its history the lake has dried up completely several times. In the north, west and south, the drainage area is formed by a mountainous ridge, whereas in the east it is flat and a surface drainage line cannot be easily drawn. The sub-surface drainage area seems to be even more complicated. The total lake area varies between 250 and 300 square kilometers, with the open water amounting to 130 to 160 square kilometers. Waulka Creek is the largest permanent discharge into Neusiedler See. A marked eutrophication was noted by limnologists investigating the lake during the last decade. The cause was traced to increased input of phosphorus. Data available suggest that such a shallow area of

water can be easily endangered by an imbalance in its water budget, an increase in the area of the reedbelt, and additional phenomena of eutrophication. One quarter of the drainage area is utilized intensively for agriculture with high nutritional dosing for growing grapes, sugar beet, vegetables and other crops. Some 15% of the drainage area consists of forest, 2% of orchards, 2% of sealed surfaces, an additional 2% occupied by Lacken (brackish ponds) and 1% by swamp. The climatic properties of the area and the large evapotranspiration of the lake are of prime importance for the microclimate in the area directly surrounding the lake. At least once a year, if possible under peak conditions, every water treatment plant is checked in a 24 hr run for load entering, load leaving, oxygen uptake, iron dosed and additional features. (Baker-FRC)
W82-02090

SOME EFFECTS OF SEWAGE DISCHARGE UPON PHYTOPLANKTON IN HONG KONG,
Fisheries Research Station, Aberdeen (Hong Kong).
G. B. Thompson, and J. Ho.
Marine Pollution Bulletin, Vol 12, No 5, p 168-173, May, 1981. 5 Fig, 22 Ref.

Descriptors: *Phytoplankton, *Wastewater disposal, *Species composition, *Chlorophyll a, *Hong Kong, Coastal waters, Estuaries, Water pollution sources, Water pollution effects.

Chlorophyll a and species composition were determined in the coastal waters of Hong Kong, December 1974 to July 1976, to survey the impact of 280 million tons of untreated sewage which is discharged into Victoria Harbor each year. Chlorophyll a in the western coastal area, characterized by estuarine conditions, was 2-6 micrograms per liter (maximum 8.3 micrograms per liter). In the central section, Victoria Harbor, site of the sewage outfalls, chlorophyll a levels were as high as 20.2 micrograms per liter. To the east, where oceanic conditions prevail, chlorophyll a reached a maximum of 2.6 micrograms per liter. Taxonomic diversity was unaffected by pollution except in summer, when Chaetoceros spp. were predominant in net phytoplankton samples. During autumn early winter, Skeletonema costatum was abundant in the polluted Victoria Harbor area. (Cassar-FRC)
W82-02095

5D. Waste Treatment Processes

COMPOSITION OF FRUIT AND VEGETABLE PROCESSING WASTES,
Orange Free State Univ., Bloemfontein (South Africa). Dept. of Microbiology.
B. A. Prior, and H. J. Potgieter.
Water SA, Vol 7, No 3, p 155-159, July, 1981. 5 Fig, 3 Tab, 13 Ref.

Descriptors: *Food-processing wastes, *Byproducts, *Carbohydrates, Effluents, Fruit crops, Vegetable crops, Waste disposal, Aquaculture.

The composition and variability of effluent produced by pineapple and fruit and vegetable canneries were investigated over a one year period. All samples were analyzed for: chemical oxygen demand, Kjeldahl nitrogen, phosphorus, carbohydrate, reducing sugars, pH, and microbial count. The effluents were found to be especially rich in carbohydrates. For pineapple effluent, the mean weekly carbohydrate concentration was 19.8 g/liter, the daily mean was 20.3 g/liter, and the hourly mean was 14.2 g/liter. The weekly mean carbohydrate concentration in effluent of the fruit and vegetable cannery was 2.1 g/liter for stream A and 1.9 g/liter for stream B. Treatment of the effluent by biological wastewater treatment methods would be difficult because of the low nitrogen and phosphorus contents relative to the high COD. Conversion of the pineapple effluent into yeast protein is feasible. An alternative would be to produce ethanol. The fruit and vegetable cannery effluent is not suitable for by-product recovery, and a traditional disposal technique such as land disposal should be considered. This effluent may have to be screened before piping, and gypsum may have to be added to counteract the sodium. (Small-FRC)
W82-01601

STEP FED PLUG FLOW REACTOR FOR BIOLOGICAL WASTEWATER TREATMENT VERSUS CONTINUOUS FLOW STIRRED TANK REACTOR (CFSTR),
Technion-Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
M. Green, and G. Shelef.
Journal of Environmental Sciences, Vol 24, No 4, p 25-26, July/August, 1981. 1 Fig, 8 Ref.

Descriptors: *Wastewater treatment, *Plug flow, Sludge, Effluents, Flow, Continuous flow, Suspended solids, Biological oxygen demand, Activated sludge process, Activated sludge, Comparison studies.

The two general categories of continuous flow reactors in use for handling wastewater are the ideal continuous flow stirred tank reactor (CFSTR) and the ideal plug flow reactor. These two categories are compared in this paper. CFSTRs are characterized by essentially constant levels of solids, organic matter, and oxygen demand throughout the reactor. CFSTRs for biological wastewater treatment usually operate under severe substrate limiting conditions, dictated by the final effluent quality requirements. The efficiency of these systems is relatively low, as the specific substrate removal rate is proportional to the substrate concentration. The nominal sludge age is higher than the bacterial lifetime, so most of the sludge cells are dead. The ideal plug flow is defined as a laminar flow under conditions of perfect mixing in the lateral plane and no mixing in the longitudinal direction. A step fed plug flow reactor is a special case of a plug flow reactor in which the reactor receives the inflow in several points throughout its length. A higher sludge viability is achieved. A step fed plug flow reactor for biological wastewater treatment inherently has two advantages over a CSTR. The first is the possibility of working under substrate saturation conditions and hence under conditions of high specific substrate removal rates, and the second, an increase in the biomass net growth rate along the system, which results in a higher sludge viability. To achieve a maximum removal efficiency, a step fed plug flow system should be highly loaded along most of its length, while to achieve high performance the end section of the plug flow reactor should remain without feeding and allow for enough flow time to obtain highly polished effluent. Studies have shown that the use of sewage conveyance conduits for wastewater treatment by biological sludge introduction and air can give effluent of secondary quality. (Baker-FRC)
W82-01618

INFLUENCE ON GROUNDWATER FROM THE BERMED INFILTRATION POND,
Dorchester County Health Department, Cambridge, MD.
L. W. Coble, Jr.
Journal of Environmental Health, Vol 44, No 1, p 27-31, August, 1981. 6 Fig, 2 Tab, 13 Ref.

Descriptors: *Groundwater pollution, *Ponds, *Infiltration, *Wastewater disposal, Domestic wastes, Municipal wastes, Wastes, *Wastewater treatment, Bacteria, Septic tanks, Groundwater recharge, Aerobic conditions, Aerobic treatment, Water pollution sources.

The bermed (diked) infiltration pond concept involves pretreating household wastes by means of a conventional septic tank with the effluent being pumped to an open or closed sand filter, and subsequently to the pond. The household wastes may also be pretreated by an aerobic treatment unit and pumped directly to the pond. Dilution, surface area, chemical reactions, and algae action are all involved in final treatment of the pretreated wastewater in the pond. Large volumes of water enter the pond from precipitation, surface drainage from inside the berm, and the pretreated wastewater. Water leaves the pond by evaporation and infiltration. The pond excavation must expose a permeable water-bearing substratum that will transmit water. The water-bearing substratum helps to maintain the pond water level, which would otherwise be lowered by evaporation during the summer months. The bermed infiltration pond allows unconfined groundwater recharge. The large pond size provides storage capacity and adequate infiltration area to allow effective infiltration during the wet season when water tables are highest and percolation rates retarded by saturated soil conditions. The pretreatment of the household wastewater is sufficient to allow further treatment in the bermed infiltration pond without the pond becoming anaerobic. Movement of nitrate nitrogen and growth of coliform and fecal coliform bacteria are not observed in the groundwater outside the pond excavation. Movement of chlorides and phosphorus in the groundwater can be expected about 150 feet from the pond. Therefore, increased deep well separation distances from 50 to 150 feet for this source of contamination and large parcel size requirements are justified to protect the residents' and adjacent property owners' water supplies. (Baker-FRC)
W82-01622

NITROUS OXIDE EMISSION FROM SIMULATED OVERLAND FLOW WASTEWATER TREATMENT SYSTEMS,
Louisiana State Univ., Baton Rouge. Lab. for Wetland Soils and Sediments.
C. J. Smith, R. L. Chen, and W. H. Patrick, Jr.
Soil Biology and Biochemistry, Vol 13, No 4, p 275-278, 1981. 3 Fig, 2 Tab, 19 Ref.

Descriptors: *Nitrous oxide, *Land disposal, *Wastewater treatment, Wastewater disposal, Waste disposal, Nitrogen, Ammonia, Overland flow, Flow, *Air pollution sources.

The contribution of overland flow wastewater treatment systems to the atmospheric concentration of nitrous oxide was investigated. A low permeability Mhoon slit loam soil from Baton Rouge, Louisiana was used in the study. Soil preparation involved air drying and sieving. About 27 kg air-dried limed or unlimed Mhoon soil was uniformly packed into each of 4 test models to a depth of 10 cm. The soil was compacted to a bulk density similar to that existing under natural conditions. The soil surface was seeded with perennial ryegrass at a rate of 100 g/square meter and watered occasionally with tapwater until germination. The models were maintained for 4 weeks by adding wastewater to establish the sod and establish a nearly constant rate of N transformations. Wastewater used was a secondary treated effluent from the Baton Rouge treatment plant. The overland flow system of wastewater disposal produced or caused a net nitrous oxide evolution to the atmosphere. Liming the soil increased the nitrous oxide evolution about 4-fold in comparison to that of the unlimed soil receiving wastewater containing 10 microg ammonium-nitrogen/ml. The rate of nitrous oxide evolution from the limed and unlimed soil systems was estimated to be 6.0 and 1.5 kg nitrous oxide-nitrogen/ha/yr, respectively. The increased rate of nitrous oxide evolution observed when the soil pH was increased from 5.8 to 7.1 is possibly due to an increase in the nitrification and denitrification rates. The mechanism for the production of nitrous oxide in the soil-plant microcosm is not known. (Baker-FRC)
W82-01624

CENTURY-OLD BOARD MILL OPERATES WITH ZERO EFFLUENT DISCHARGE,
J. C. W. Evans.
Pulp and Paper, Vol 55, No 7, p 98-99, July, 1981.

Descriptors: *Pulp and paper industry, *Waste recovery, *Recycling, *Water reuse, Performance evaluation, Wastewater treatment, Filtration, Flocculation, Clarification, Industrial wastes, Biocides, Corrosion control.

The Halltown Paperboard Company mill, located on a stream emptying into the Shenandoah River, has been recycling all effluent from its production of paperboard from wastepaper since 1969. Before

the changeover to recycling of its waste water, the mill occassionally had to close due to water shortages. To eliminate the need for freshwater in the system, some internal 'closed loops' such as liner white water from the paper machine was recirculated back to the liner pulper. An old stream bed running under the mill carries all effluent back to a pumping station. From here, the effluent is pumped to the water treatment clarifier and the fiber is recovered by Hydrasieves. Sludge is pumped from the bottom of the clarifier to the filler pulper. Clarified water is aerated and stored for use in the liner and filler pulpers. Suspended solids in the clarifier are settled by the polymer used as a drainage aid. Biocides are used to control bacteria and slime. The mill has experienced breakdowns in the clarifier, causing spills into the nearby stream, as well as many other failures in the closed system. Use of stainless steel has corrected severe corrosion problems, and the need for constant maintenance is slowly diminishing. (Geiger-FRC)
W82-01626

USING ZETA POTENTIAL TO OPTIMIZE COAGULATING AID DOSES USED TO TREAT FOOD PROCESSING WASTES,
Cornell Univ., Ithaca, NY. Dept. of Food Science.
F. W. Welsh, and R. R. Zall.
Process Biochemistry, Vol 16, No 4, p 31-33, 42, June/July, 1981. 6 Fig, 1 Tab, 13 Ref.

Descriptors: *Food-processing wastes, *Zeta potential, Monitoring, Industrial wastes, Suspended solids, *Coagulation, *Wastewater treatment, Water treatment, Chemical oxygen demand.

The purpose of this paper is to indicate a use for zeta potential analysis as a method of monitoring coagulation processes used in treating food processing liquid waste effluents. Three different kinds of food processing liquid waste effluents were studied: from a fruit juice processing operation, from a scallop shucking operation, and from an egg washing operation. Jar test results for the three wastes were compared to zeta potentials. The fruit juice processing waste effluent samples were an example of the low colloidal concentration type of waste. A small net zeta potential change, from the initial zeta potential to the optimum zeta potential, occurred with the minimization of sample turbidity. Food processing wastes containing large amounts of colloidal materials are more easily treated with coagulants. This improved coagulant treatability of the waste must also be observable from the zeta potential analysis results. The scallop shucking wastewater was an example of a colloidal type of waste. For this waste, the net zeta potential change was 15 mv. The waste parameter concentration removed from the scallop shucking waste effluent at its optimum coagulant does was significantly different from its pH adjusted counterpart. The largest net zeta potential change (30 mv) was noted with the egg washing effluent. This highly colloidal effluent also exhibited the largest suspended solids reduction. A first order relationship was noted between the changes in the colloidal solids concentration as measured by suspended solids, content of the waste and the net change in zeta potential. Thus coagulant treatability of a food processing waste effluent is a function of the zeta potential change, as it is affected by the suspended solids change of the wastewater. Zeta potential can be used to monitor coagulation processes for effluent treatment. (Baker-FRC)
W82-01627

REMOVAL OF ORGANICS FROM WATER BY GRANULAR ACTIVATED CARBON AND MICROORGANISMS,
National Coal Board, Stoke Orchard (England). Coal Research Establishment.
J. Wilson.
Process Biochemistry, Vol 16, No 4, p 9-12, June/July, 1981. 2 Fig, 38 Ref.

Descriptors: *Water treatment, *Activated carbon, Carbon adsorption, Microorganisms, Bacteria, Biological treatment, Reviews, *Wastewater treatment, *Organic compounds, Dissolved solids.

While the treatment of wastewater by biological methods is widespread, the treated water may remain contaminated and unsuitable for discharge to waterways. As an extra treatment stage to remove soluble organics that persist an obvious development is the use of granular activated carbon (GAC) along with biological treatment. Experiences of enhanced removal of organics from contaminated water by GAC as a result of adventitious biological activity on the GAC have been reported for a number of cases ranging from pilot to full-scale plants. A large advanced water treatment pilot plant at Pomona, California is cited where municipal wastewater was treated. At this plant of 45 cubic meter/hr capacity, effluent from an activated sludge plant was passed downwards through GAC columns. Removal of organics was better than expected; this was attributed to the action of biological flora that had become established adventitiously in the GAC beds. Early experience with the nuisance of sulfide emission, caused by anaerobic biological activity on sulfates in the water, was obtained at the Blue Plains Advanced water treatment plant, operating at 8 cubic meter/hour capacity on municipal wastewater. The addition of sodium nitrate to the GAC influent stopped sulfide emission and enhanced biological oxidation on GAC. The combination of ozone and GAC with biological activity is of increasing interest in wastewater treatment, especially in the US, and some case histories are cited. A method of regeneration has been developed that relies on biological activity as an alternative to thermal processes. Disadvantages of biological activity on GAC and areas needing further study include: the nature of the compounds produced by bacterial action, including toxicity; high bacterial counts in GAC effluents; and the production of polar, partly adsorbable compounds with the use of ozone. (Baker-FRC)
W82-01628

WATER REUSE: ULTRAFILTRATION OF INDUSTRIAL AND MUNICIPAL WASTEWATERS,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
E. R. Christensen, and K. W. Plaumann.
Journal of the Water Pollution Control Federation, Vol 53, No 7, p 1206-1212, July, 1981. 4 Fig, 7 Tab, 19 Ref. OWRT-R-0048(7809)(1), 14-34-0001-7809.

Descriptors: *Ultrafiltration, *Water reuse, *Industrial wastes, Filtration, Wastewater treatment, Municipal wastes, Membrane filters, Performance evaluation, Organic carbon, Separation techniques.

The potential role for ultrafiltration in industrial and municipal water reuse was evaluated, working with plate-and-frame systems and wastewaters from the textile, food, pulp and paper, and general manufacturing industries, and from a wastewater treatment plant. An on-site study was performed using secondary effluent from a municipal wastewater treatment plant. The wastewaters most suitable for ultrafiltration appeared to be: textile bleach, oily waste, secondary effluent, polyvinyl alcohol, and pulp and paper waste in that order. More than 40% total organic carbon was removed using a fluoro-polymer membrane; for pulp and paper waste, 58% total organic carbon removal was obtained with a cellulosic membrane. The secondary effluent study found about 50% total organic carbon removal with fluoro-polymer, polysulfone, and polytetrafluoroethylene membranes. A typical minimum energy requirement was 4.60 k Wh/cu m for the filtration of secondary effluent with a polysulfone membrane. (Small-FRC)
W82-01652

THE EFFECTS OF SECONDARY SEWAGE EFFLUENT ON THE WATER QUALITY, NUTRIENT CYCLES AND MASS BALANCES, AND ACCUMULATION OF SOIL ORGANIC MATTER IN CYPRESS DOMES,
Florida Univ., Gainesville.
For primary bibliographic entry see Field 5G.
W82-01687

WATER PURIFICATION STUDIES WITH ACTIVATED CARBON AND FOAM FLOTATION,
Vanderbilt Univ., Nashville, TN.
N. A. K. Mumallah.
PhD Dissertation, 1980. 156 p, 19 Fig, 33 Tab, 121 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-01683.

Descriptors: *Wastewater treatment, *Separation techniques, Water pollution control, Water purification, *Foam separation, Heavy metals, Flotation.

The floc foam flotation of chromium (III) with ferric hydroxide and NLS; the precipitate foam flotation of copper using the chelating agents dodecyldithiocarbamate and LIX-reagents; precipitate flotation of nickel, cobalt, manganese, zinc and cadmium with LIX-reagents; and precipitate flotation of copper, manganese and zinc using mono lauryl phosphate are reported. The effects of pH, ionic strength and the presence of interfering anions such as SO4(2-), HPO4(2-) and EDTA on these foam flotations have been investigated. The objectives of the work were to develop a satisfactory flotation method for chromium and to examine the abilities of some novel chelating surfactants to carry out effective flotation in the presence of ions which interfere with NLS. (Sinha-OEIS)
W82-01692

SLOWHILL COPSE SEWAGE TREATMENT WORKS.
Water Services, Vol 85, No 1025, p 335-337, July, 1981. 7 Fig.

Descriptors: *Wastewater facilities, *Wastewater treatment, Water treatment facilities, Sewer systems, Primary wastewater treatment, Advanced wastewater treatment, Sludge, *Southampton, *England.

A description is offered of the new sewage treatment works at Slowhill Copse. The new works is being built in two phases. Phase I, already operational, provides preliminary treatment and primary settlement for all present flows, which are then discharged to Southampton Water via the original works outfall. The maximum design dry weather flow for phase 1 is 23,270 cubic meters/day from a contributing population of about 45,000 persons. Phase 2 will complete the project and will provide the secondary and sludge treatment processes, with effluent to Royal Commission standard being discharged to Southampton Water via a new works outfall of 1350 mm diameter. The main structures being built for phase 2 are aeration channels, final settlement tanks, return activated sludge system, sludge consolidation tanks, sludge treatment buildings, pipelines, services and roads. The main structures of phase 1 include primary settlement tanks, storm tanks, modifications to the existing primary sedimentation tanks, the electrical and control buildings and associated pipelines and services. The works follow a conventional pattern of treatment such as screening, grit removal, primary settlement, biological treatment by surface aeration, and final settlement. The major building structure is the sludge treatment building, which comprises a deep basement housing the sludge pumping equipment and wet wells, a sludge thickening hall which houses two Komline Sanderson flotation thickener units, and the associated chemical dosing and compressed air units. (Baker-FRC)
W82-01727

PARASITE EGG AND CYST REDUCTION IN OXIDATION DITCHES AND AERATED LAGOONS,
National Environmental Engineering Research Inst., Nagpur (India).
P. V. R. C. Panicker, and K. P. Krishnamoorthi.
Journal of the Water Pollution Control Federation, Vol 53, No 9, p 1413-1419, September, 1981. 9 Fig, 3 Tab, 22 Ref.

Descriptors: *Wastewater treatment, *Oxidation, *Parasites, Oxidation ditches, Oxidation lagoons, Oxidation ponds, Ponds, Effluents, Human diseases, *Aerated lagoons, Public health, *India.

The efficiency of removal of helminth eggs and protozoan cysts in nonconventional pilot wastewater treatment systems such as the oxida-

tion ditch and aerated lagoon at the Nagpur campus of the National Environmental Engineering Research Institute was examined. Egg and cyst counts in individual raw wastewater samples varied from 122 to 860 organisms per liter. In raw wastewater, protozoan cysts (Entamoeba histolytica and Giardia lamblia) formed the majority, whereas the helminth eggs were comparatively fewer in number. The majority of protozoan cysts and helminth eggs were removed during the process of treatment in the oxidation ditch. The efficiency of the oxidation ditch as a means of removing the parasites compares favorably with that of the activated sludge process, with the removal of Ascaris in a majority of samples ranging from 95 to 100%. During this study the biochemical oxygen demand reduction ranged from 95 to 99%, and the effluent BOD was up to 10 mg/liter. With a three day detention time, the average BOD removal in the lagoon was 81.4%. BOD of the final effluent ranged between 12 and 45 mg/l, with an average of 27 mg/l. The presence of relatively large numbers of cysts and eggs in the lagoon effluents indicates improper settling. Addition of a settling tank is needed to improve the quality of the effluent. The present study did not include variability experiments. No correlation was found in this study between the removal of parasites and some operational conditions such as increased retention time, SRT, or MLVSS. Removal efficiency in the aerated lagoon was less than that of the oxidation ditch. (Baker-FRC)
W82-01733

EFFECT OF THE COPPER CONTENT OF DISTILLERY SPENT WASH ON ITS UTILIZATION FOR SINGLE-CELL PROTEIN PRODUCTION BY GEOTRICHUM CANDIDUM, HANSENULA ANOMALA AND CANDIDA KRUZEI,
New Univ. of Ulster, Coleraine (Northern Ireland). School of Biological and Environmental Studies.
For primary bibliographic entry see Field 5C.
W82-01750

EFFECT OF REAGENT MIXING RATE ON ADSORPTION PROCESS FOR AM-FE2O3.H2O,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W82-01799

REMOVAL OF ELEMENTAL MERCURY FROM WASTEWATERS USING POLYSULFIDES,
Domtar Ltd. Research Center, Senneville (Ontario).
D. M. Findlay, and R. A. N. McLean.
Environmental Science and Technology, Vol 15, No 11, p 1388-1390, November, 1981. 1 Tab, 8 Ref.

Descriptors: *Sodium polysulfide, *Mercury, *Chloralkali plants, Sulfides, Polysulfides, *Wastewater treatment, Chemical wastewater, Industrial wastewater, Metals, Heavy metals.

Sodium polysulfides removed both elemental and ionic mercury from wastewater and sludge from a Hg cell chloralkali plant. In plant operation, addition of 20 ppm sodium polysulfide to the existing treatment (37 ppm sodium hydrosulfide and 75 ppm FeCl3) reduced Hg concentration to an average of 11 ppb, compared to 87 ppb without Na polysulfide. The sludge resulting from brine treatment contained 150 ppb elemental Hg and 5200 ppb total Hg. Various treatments reduced Hg concentrations to the following levels: 50 ppm Na hydrosulfide alone, 30 ppb elemental and 430 ppb total; Na polysulfide alone, 3 ppb elemental and 65 ppb total; and 50 ppm of each, 3 ppb elemental and 53 ppb total. In a brine sludge sample with 720 ppb elemental Hg and 1390 ppb total Hg polysulfide alone reduced concentrations of Hg to 1 ppb and 20-30 ppb, respectively. Best results are obtained when pH is maintained at 9-12, polysulfide solution is less than 1 week old, chlorine or hypochlorite are removed, and 75-100 ppm FeCl3 is added as a flocculant. (Cassar-FRC)
W82-01800

PRECIPITATE FLOTATION STUDIES WITH MONOLAURYL PHOSPHATE AND MONOLAURYLDITHIOCARBAMATE,
Vanderbilt Univ., Nashville, TN. Dept. of Chemistry.
N. A. Mumallah, and D. J. Wilson.
Separation Science and Technology, Vol 16, No 3, p 213-228, 1981. 1 Fig, 6 Tab, 35 Ref.

Descriptors: *Chemical precipitation, *Flotation, *Metals, *Ions, Copper, Zinc, Magnesium, Monolauryl phosphate, Lauryldithiocarbamate, Chelating agents, *Wastewater treatment, Industrial wastes, Separation techniques.

The precipitate flotation of copper(II), manganese(II), and zinc(II) with monolauryl phosphate was investigated at various pH's and ionic strengths. Also, the potential of lauryldithiocarbamate to chelate copper(II) and remove it by foam flotation was evaluated at various pH's and in the presence of various anions which show interference in the removal of Cu(II) by flotation. At pH's of 7-10, very good removal of Cu(II) precipitated as the hydroxide followed flotation, but below pH 7 removal was difficult. When Cu(II) was coprecipitated with ferric hydroxide and floated with lauryl phosphate, good removal was also obtained in the pH range 1-10. Mn(II) was removed successfully by flotation with lauryl phosphate in less than 10 min, and Zn(II) removal was successful when Zn(II) was coprecipitated with ferric hydroxide in the ratio Fe:Zn of 2 or more and at pH's of 8.5-10. Lauryl phosphate was much better than sodium lauryl sulfate, dithiocarbamate, or other commercial reagents in removing transition metal ions from aqueous solution. (Small-FRC)
W82-01863

DETROIT'S WWTP: ONE OF THE WORLD'S BIGGEST,
Detroit Dept. of Water Supply, MI. Water and Sewer Treatment.
A. C. Davanzo.
Water/Engineering and Management, Vol 128, No 9, p 38-41, September, 1981.

Descriptors: *Wastewater treatment, *Secondary wastewater treatment, *Sludge disposal, Sewage systems, Phosphorus removal, Water pollution prevention, Remote control, Effluent limitations, Water quality standards, Aeration, Incineration, Waste disposal, *Wastewater facilities, Detroit.

The Detroit wastewater treatment plant, which provides treatment for over 76 communities, is described. An extensive sewage collection network with monitoring devices forms the backbone of the system. Work to build interceptors to collect the flow of perpendicular trunk sewers was delayed until 1940. At present the plant processes an average of 650 mgd, with peaks to 900 mgd. Pumping, primary treatment and solids disposal capacities were expanded in the 1950's and 1960's to meet increased loads from an increasing population. In the 1960's plans were made to improve effluent discharges by phosphorus removal. An oxygen aeration system was also adopted in the early 1970's. Some effluent quality problems arose in the latter part of this decade, which were handled by increased staff and better training of plant personnel. Solids disposal is still a problem. Fourteen multiple hearth incinerators are used to handle solids; however, measures to meet air pollution standards are still being studied. Industrial wastes contribute large amounts of grease, which is handled by landfilling. Inlet modifications have solved the problems of the peripheral inflow/outflow clarifiers. (Geiger-FRC)
W82-01865

SIMPLE RETENTION TIME ANALYSIS IN TRICKLING FILTERS USING CONDUCTIVITY,
Trinity Coll., Dublin (Ireland).
N. F. Gray.
Effluent and Water Treatment Journal, Vol 21, No 8, p 345-347, August, 1981. 3 Fig, 12 Ref.

Descriptors: *Trickling filters, *Conductivity, *Tracers, *Retention time, Sodium chloride, Performance evaluation, Costs, *Wastewater treatment.

A comprehensive assessment was performed of all the non-radioactive tracers available for the measurement of retention time in trickling filters. Sodium chloride was the most convenient. The rate of adsorption of the chloride by the biological film was relatively constant, especially over short periods of time. Also, it had only an extremely slight effect on the treatment process, and consequently a low environmental impact. Sodium chloride has a low bulk cost when compared to other possible tracers. A simple conductivity meter and cell can be used to monitor the chloride. The method is simple, rapid, reproducible, and economical, making it possible to include the regular measurement of retention time in the routine assessment of trickling filter efficiency. (Small-FRC)
W82-01876

A MULTILEVEL MODEL AND ALGORITHM FOR SOME MULTIOBJECTIVE PROBLEMS,
Chiyoda Chemical Engineering and Construction Co. Ltd., Yokohama (Japan).
For primary bibliographic entry see Field 6A.
W82-01884

ACTIVATED SLUDGE NICKEL TOXICITY STUDIES,
Chulalongkorn Univ., Bangkok (Thailand). Inst. of Environmental Research.
S. Sujarittanonta, and J. H. Sherrard.
Journal of the Water Pollution Control Federation, Vol 53, No 8, p 1314-1322, August, 1981. 7 Fig, 1 Tab, 30 Ref.

Descriptors: *Activated sludge process, *Nickel, *Toxicity, Heavy metals, Metals, Nitrification, Wastewater treatment, Biological treatment, Microorganisms, Aerobic digestion, Organic loading.

The effects of nickel on the activated sludge process were studied in three laboratory experimental units and a control and found to depend on COD:Ni(2+) ratio, microorganism concentration:Ni(2+) ratio, and operating mean cell residence time. The feed solutions contained: (1) 1 mg per liter Ni(2+) and 396 mg per liter COD, (2) 5 mg per liter Ni(2+) and 391 mg per liter COD, and (3) 1 mg per liter Ni(2+) and 787 mg per liter COD. In all three feed solutions Ni reduced COD removal efficiency slightly as compared to the control, indicating that activated sludge performance was not influenced by metal ion concentration alone but was also dependent on wastewater strength and mean cell residence time. Nitrification was significantly inhibited by solutions (1) and (2) but not by solution (3). Nitrifying organisms were much more sensitive to Ni than were heterotrophic organisms. Both COD removal efficiency and toxicity to nitrifiers appeared to be dependent on the ratio of COD:Ni(2+) rather than on the concentration of Ni(2+) alone. Values of Y max (microorganism cell yield) and b (maintenance energy coefficient) were higher in solutions (1) and (2) than in the control. This was attributed to a shift in microbial species as a response to Ni or to the stimulatory effects of Ni on microbial activity. Microorganism concentration increased with increased mean cell residence time, and toxicity was related to the ratio of Ni concentration to biomass concentration. (Cassar-FRC)
W82-01895

EXTRACTION OF COPPER WITH LIQUID SURFACTANT MEMBRANES,
Kyushu Univ., Fukuoka (Japan). Dept. of Organic Synthesis.
F. Nakashio, and K. Kondo.
Separation Science and Technology, Vol 15, No 4, p 1171-1191, 1980. 13 Fig, 23 Ref.

Descriptors: *Wastewater treatment, *Copper, *Surfactants, Separation techniques, Heavy metals, Chelating agents, *Membrane filters, Solvents, Hydrogen ion concentration, Metallurgy, Metals, Metal complexes.

Interest in the application of solvent extraction for the recovery of metals has increased, especially in

industrial resource recycling, hydrometallurgical processing and waste water treatment. The extraction of copper using liquid surfactant membranes containing a mobile carrier was conducted in a stirred transfer cell. The resistance of the diffusion step in the liquid surfactant membrane was negligible when compared with that of the diffusion step along with chelating complex formation in the extraneous aqueous solution. Initial rates of copper extraction varied inversely as the 0.5 power of hydrogen-ion concentration at low pH levels, but were not affected by hydrogen-ion concentrations at high pH levels. In the low pH range, the initial rate of copper extraction was proportional to the level of benzoylacetone, the mobile carrier in the membranes. At high pH and high benzoylacetone levels, the initial rate of copper extraction was affected very little by the concentration of the mobile carrier. The batch-type stirred tank findings support a model of liquid surfactant membranes which is presented. Further work is needed on the effects of emulsion breakdown which may occur after longer treatment periods. (Geiger-FRC)
W82-01896

OXYGEN BLEACHING SHOWS POTENTIAL FOR REDUCING COSTS, EFFLUENT PROBLEMS,
MoDo-Chemetics, A. B., Ornskoldsvik (Sweden).
L. Almberg, A. Jamieson, and S. Waldestam.
Pulp and Paper, Vol 54, No 3, p 92-95, March, 1980. 4 Fig, 6 Tab, 5 Ref.

Descriptors: *Bleaching wastes, *Oxygen, *Pulp and paper industry, Biological treatment, Economic aspects, Cost, Performance evaluation, Wastewater treatment, Industrial wastes.

A comparative economic analysis was made of oxygen bleaching vs. biological treatment at a mill making fully bleached softwood kraft pulp. Two cases were examined: one where the mill already exists and the pollution abatement process is added, and the other where a more extensive investment is contemplated. Installation of an oxygen stage in an existing bleach line will permit reduction in pollution quantities by 42-79% while saving up to $1/ton of pulp after allowing for depreciation. The capital cost would be about $8.8 million. In a new plant, installation of an oxygen bleaching sequence instead of a non-oxygen sequence would reduce pollution by 35 to 60%, while saving about $5/ton of pulp after allowing for depreciation. The extra capital costs would be about $4.9 million. Energy costs are an area of current concern, and mills can generate much or all of the direct energy required from waste liquor or wood. Sequence plays a major role in making the mill less sensitive to future oil prices. (Small-FRC)
W82-01899

SELECTIVE REMOVAL OF HEAVY METAL IONS FROM AQUEOUS SOLUTIONS BY DIAFILTRATION OF MACROMOLECULAR COMPLEXES,
Forschungsinst. Berghof G.m.b.H., Tuebingen (Germany, F.R.).
H. Strathmann.
Separation Science and Technology, Vol 15, No 4, p 1135-1152, 1980. 11 Fig, 3 Tab, 5 Ref.

Descriptors: *Heavy metals, *Membrane filters, *Ultrafiltration, *Industrial wastes, Separation techniques, Ion exchange, Waste water treatment, Filtration, Chelating agents, Mathematical equations, Precipitation, Metal complexes.

A method for selectively removing heavy metal ions from aqueous solutions by a combined process of ultrafiltration and treatment with macromolecular chelating agents or emulsified liquid ion exchange materials is described. The macromolecular complex should have high selectivity, water solubility and binding capacity, and narrow molecular weight distribution. The membrane should exhibit high flux and a sharp molecular weight cut-off. Mathematical equations for determining the enrichment factor, complex capacity and polymer solubility are given, and fractional losses of metal due to incomplete rejection of the complex are discussed. Necessary conditions for polarization, polymer precipitation, and the emulsified liquid ion exchanger are outlined. Chelating agents are evaluated in terms of their selectivity, capacity, and load factor. The selective removal of heavy metal ions from industrial effluents was examined in laboratory tests. (Geiger-FRC)
W82-01900

ENVIRONMENTAL DESIGN AND OPERATION OF NANTICOKE THERMAL GENERATING STATION,
Ontario Hydro, Toronto. Central Thermal Services.
P. M. Wiancko.
Journal of Great Lakes Research, Vol 7, No 2, p 96-104, 1981. 5 Fig, 2 Tab, 8 Ref.

Descriptors: *Industrial wastes, *Thermal powerplants, *Monitoring, *Environmental effects, Water pollution sources, *Lake Erie, Canada, Wastewater treatment, *Nanticoke Thermal Generating Station.

The various systems of the Nanticoke Thermal Generating Station which interface with the environment are described, and monitoring activities designed to monitor possible environmental effects are outlined. The 4,000 MW fossil-fueled plant is located on the north shore of Long Point Bay on Lake Erie. Up to 150 cu m/sec of cooling water is used: 60% for condenser cooling and 40% for discharge tempering. Chemical-laden wastes, fly ash and bottom ash, treatment plant wastes, coal pile drainage, and sewage are retained in a 76 ha lagoon for about forty days. The lagoon drains constantly into the lake at a rate of 0.4 cu m/sec. The station monitors all water processing and waste systems, air quality (for SO2), fugitive coal dust, fish impingement, and seasonal stack impingement of migrating birds. To date, the aquatic environment in the area has remained relatively stable. (Small-FRC)
W82-01907

TECHNOLOGY AND PERFORMANCE OF THE HI-CAPACITY THICKENER,
Envirotech Corp., Salt Lake City, UT.
R. C. Emmett, and R. P. Klepper.
Mining Engineering, Vol 32, No 8, p 1264-1269, August, 1980. 4 Fig, 3 Tab, 3 Ref.

Descriptors: *Mine wastes, *Flocculation, *Clarification, *Wastewater treatment, Industrial wastewater, Coal, Uranium, Iron, Ores, Coagulation, High capacity thickener, Pilot plants, Thickeners, Separation techniques.

The high capacity thickener (HCT) for clarifying mining wastes was studied on the pilot plant scale using wastewaters from coal, uranium, and iron ore processes. Feeds from 4 coal preparation plants (3 producing refuse tailings from froth flotation, and 1 producing a -28 mesh size fraction of coal and refuse) containing 2-15% solids were treated in the HCT with 1-30 ppm anionic thickener. Underflow solids concentrations of 25-39 weight % were produced at 10 times the conventional loading rate. Iron ore concentrate and acid soluble precipitate from a uranium process were successfully treated in a pilot plant with little operator attention. Using iron ore tailings, the HCT also performed comparably to conventional thickeners at the same flocculation dosage. The HCT produced underflow concentrations as high as 63% from a feed containing neutral uranium ore without any difficulty. Maximum benefits from flocculation may be obtained by: mechanical flash mixing of flocculant and pulp, staged addition (at least three stages) of flocculant, introduction of flocculated slurry beneath the pulp level, damping feed fluctuation by inclining the plate zone in the region above the feed inlet, sufficient compression volume beneath the feed inlet, higher than normal raking torque, and reliable instrumentation and control systems. (Cassar-FRC)
W82-01929

SUBSTRATE FLUX INTO BIOFILMS OF ANY THICKNESS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
B. E. Rittmann, and P. L. McCarty.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 831-849, August, 1981. 8 Fig, 2 Tab, 20 Ref.

Descriptors: *Bacteria, *Substrates, *Fluctuations, Mathematical models, Biomass, Films, *Wastewater treatment, Biological wastewater treatment, Nutrients, Water treatment.

Bacteria which grow as fixed films may have a significant influence on many biological processes in nature and in water and wastewater treatment plants. Steady-state biofilms are defined as those which are not growing or decaying over time. The substrate flux and thickness of a steady-state biofilm can be predicted from the substrate concentration and fundamental biofilm parameters and are based on the kinetics and energetics of substrate utilization and biofilm growth. A model has been developed for estimating the substrate flux into a biofilm of any thickness. The inclusion of mass-transport resistance in the model causes the flux to become a direct function of the bulk substrate concentration. This model can be used to predict the flux of a single, rate-limiting substrate when the biofilm thickness is independently known, even though the biofilm thickness can be nonsteady-state. This may happen when a biofilm at varying bulk substrate concentrations is exposed to fluctuations in wastewater. In such a situation, biofilm thickness might be determined based on longer-term average utilization rates. Experiments with short-term changes in substrate loading demonstrated that removal of substrates to levels below the minimum concentration of rate-limiting substrate able to sustain steady-state biofilm can be accomplished in the short term by nonsteady-state biofilms which undergo net decay and that the model can successfully predict substrate utilization from independently derived parameters if reasonable estimates of the biofilm thickness are available. (Carroll-FRC)
W82-01964

HYDRAULIC MODELING FOR WASTE STABILIZATION PONDS,
Princeton Univ., NJ. Dept. of Civil Engineering.
R. A. Ferrara, and D. R. F. Harleman.
Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EE4, p 817-830, August, 1981. 9 Fig, 1 Tab, 14 Ref.

Descriptors: *Hydraulic models, *Stabilization ponds, *Wastewater treatment, Performance evaluation, Mathematical models, Simulation analysis, Water quality, Flow characteristics.

The hydraulic transport and the biological and chemical transformation processes within a waste stabilization pond determine the treatment performance. Efforts were made to identify the appropriate hydraulic design of waste stabilization ponds using dye tracer studies and model simulations to indicate the efficiency of various pond geometries and inlet and outlet configurations. Some of the test ponds were found to have treatment efficiencies well below that of completely-mixed flow, and avoidance of these configurations is recommended. None of the ponds tested achieved the efficiency of plug flow. Evaluation of hydraulic models for water quality simulation in waste stabilization ponds showed that treatment efficiencies predicted by the completely-mixed flow model compared well with those determined by analysis of dye tracer studies. This comparison was based on treatment efficiency for first-order decaying substances at steady state. The development of a return flow model which realistically represents the transport process is reported. The model uses three input parameters: the dispersion coefficient in the active zone, the size of the active zone, and the dilution ratio. (Carroll-FRC)
W82-01965

MANAGING WATER AT HELICOPTER PLANT,
B. Rose.

Industrial Finishing, Vol 56, No 1, p 34-36, January, 1980.

Descriptors: *Reclaimed water, *Water costs, *Metal-finishing wastes, Water management, Wastewater treatment, Boiler water, Water reuse, Industrial wastewater, Aircraft, Chromium, Metals.

The use of reclaimed water has saved $60,000 a year in water and waste treatment costs and $20,000 a year in fuel costs for the Bell Helicopter Textron plant. The chromate rinse waters plus other selected wastes are routed to a surge tank, where the pH is adjusted to 6-7, if necessary. Wastewater is pumped into the reduction unit at the rate of 50 gpm. Here hexavalent chromium at concentrations of 50-60 mg per liter is continually reduced to the trivalent state by an electrochemical process using consumable iron electrodes. Further treatment involves a lamella separator, addition of polyelectrolytes, and sand filtration. The treated water, of higher quality than city or well water, is used as boiler feed water. Concentrated wastes from other processes are treated prior to discharge to the municipal sewer system. The $330,000 reclamation system has paid for itself 3 times over in about 2 years by reducing city water consumption and sewer charges, allowing boiler water to be recycled less often, and lessening the demand on the waste treatment system. (Cassar-FRC)
W82-01974

MODELING STORMWATER STORAGE/ TREATMENT TRANSIENTS: THEORY,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W82-01980

MODELING STORMWATER STORAGE/ TREATMENT TRANSIENTS: APPLICATIONS,
Duke Univ., Durham, NC. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-01981

COMBINING SEWER WATER PURIFICATION PROCESSES TO TREAT EFFLUENTS PRODUCED BY TRANSIENT POPULATIONS,
Limoges Univ. (France). Fondation de L'Eau Limoges.
G. Casteignau.
Water Science and Technology, Vol 13, No 7, p 315-329, 1981. 5 Fig, 4 Tab, 3 Ref.

Descriptors: *Wastewater treatment, *Biological wastewater treatment, *Combined treatment, *Chemical treatment, *Population dynamics, Pilot plants, Organic carbon, Phosphorus, Nitrogen, Nitrification, Nutrient removal, Chemical coagulation, Coagulation, Flocculation, France.

The added sewage produced by transient populations, especially in leisure resorts of coastal areas, sometimes exceeds the purification capacity of biological wastewater treatment processes. Comparative studies carried out in the field and in pilot plants demonstrate the value of adding coagulation-flocculation treatment to the biological treatment of sewage in areas of transient populations. The transfer of nitrogen, phosphorus and carbon charges was analyzed to evaluate the effectiveness of combined chemical and biological treatment. The production of sludge and sludge treatment by various processing patterns are compared, along with management strategies for operating combined units for the biological/physicochemical treatment of increased loadings of wastewater due to transient populations. (Geiger-FRC)
W82-01992

CONTROL OF BARK LANDFILL LEACHATES WITH AN ANAEROBIC TREATMENT SYSTEM,
Stora Kopparberg-Bergvik, Skutskar (Sweden).
S. Rydin, and P. Haglund.
Tappi, Vol 64, No 8, p 59-62, August, 1981. 7 Fig, 1 Tab, 4 Ref.

Descriptors: *Pulp and paper industry, *Wood wastes, *Leachates, Anaerobic conditions, *Wastewater treatment, Industrial wastes, Landfills, Bark, Methane, Water pollution control.

A pulp mill developed a bark landfill to treat bark leachates, reducing BOD by 90% and COD by 60%. The landfill itself acted as an aerobic filter, on which a stable methane-forming bacteria developed. In the present full-scale system, leachate from the landfill is collected in ditches, sent to a buffer pond (3000 cu meters), and pumped over the bark at 1 cu meter per min. Although the process is pH-dependent, it has not been necessary to adjust the pH, probably because some lime sludge is present. Stopping the recycling for any reason causes a temporary drop in COD removed. Heavy rain or snowmelt has not interfered, and the heat produced evaporates excess water. The installation cost $150,000, one-tenth the cost of other alternatives. (Cassar-FRC)
W82-02006

THE FLOWERING OF WASTEWATER TREATMENT,
Utah State Univ., Logan. Coll. of Engineering.
E. J. Middlebrooks, and S. C. Reed.
Water/Engineering and Management, Vol 128, No 6, p 51-54, June, 1981. 2 Tab.

Descriptors: *Wastewater treatment, *Aquatic plants, Water treatment facilities, Design criteria, Nutrients, Biological oxygen demand, Suspended solids, *Water hyacinth.

The use of aquatic plants in wastewater treatment systems to reduce the concentration of contaminants to levels equivalent to secondary, advanced secondary and tertiary effluents has been proposed and tried on a small scale over the past 10 years. The water hyacinth plant in particular appears to have potential for application in small community wastewater treatment facilities. Most commonly a stabilization pond is incorporated, followed by a series of water hyacinth culturing tanks which can produce an advanced secondary effluent. A properly designed facility is efficient, economical, and requires very little energy input. There should be no odor problem and it can be impractical in cold regions. Thus far all operations using the water hyacinth cover less than 4 hectares in area, and most are smaller than one hectare. Hyacinth systems processing a secondary effluent can be designed to handle about 2,000 cubic meters/ha/day if the principal objective is to control BOD 5 and suspended solids in the effluent. If nutrient removal is the most important consideration, the best hydraulic loadin ragte has not yet been established. Most systems have been designed to operate with three cells in series. If the purpose is to remove nutrients, it is necessary to maontain the hyacinth culture in an active growth phase, requiring that harvesting be conducted frequently. (Baker-FRC)
W82-02015

LIMNOLOGY AND PERFORMANCE OF WASTE TREATMENT LAGOONS,
Technische Univ., Dresden (German D.R.).
D. Uhlmann.
Hydrobiologia, Vol 72, No 1/2, p 21-30, July, 1980. 8 Fig, 12 Ref.

Descriptors: *Ponds, *Lagoons, *Wastewater lagoons, Wastewater treatment, *Limnology, Daphnia, Biological oxygen demand, Phytoplankton, Zooplankton, Bacteria, Sewage bacteria, Dissolved oxygen.

Sewage treatment lagoons arranged in series sever some of the connections between parts of the food web. Generally the first cell is the main site of bacterial activity, which decomposes solid and dissolved organic matter to form methane. In the second cell phytoplankton and associated bacteria operate under aerobic conditions. If the BOD load of the third cell does not exceed 5 g per cu meters per day and temperatures are not too low, high concentrations of Daphnia and other filter feeding zooplankton further reduce bacterial counts to 99% of the count in the first cell inflow. This water can be used for irrigation. Temporal fluctuations in bacteria, phytoplankton, zooplankton, and dissolved oxygen can range over two orders of magnitude. Even after upsets due to weather conditions and unusual growths, systems return to a clear water state. These ponds are usually resistant to mixing, except in tropical lowlands with warm nights, where short-circuiting is the normal situation. A chart depicts the BOD removal as a function of BOD load and residence time of the water. For example, the rate coefficient of BOD removal is 0.21 per day for 10 days residence time and BOD load of 25 g per cu meter per day. (Cassar-FRC)
W82-02026

POLLUTION FROM FARMS,
Thames Water Authority, London (England).
R. P. Wheeler.
Effluent and Water Treatment Journal, Vol 20, No 2, p 61, 63-65, February, 1980. 3 Tab, 12 Ref.

Descriptors: *Farm wastes, *Animal wastes, *Waste treatment, Water pollution sources, Hogs, Dairy industry, Wastes, Manure, Organic wastes, Farm lagoons, Lagoons, Land application, England, Wales.

In 1977 warnings were issued on 1293 cases of farm waste pollution in England and Wales. The largest percentage of these violations were concerned with dairy and yard washings and overflowing or breaking banks of manure stores. The same situations were responsible for most of the total of 76 violations in the Thames Water Authority area in 1978. A table lists the types of farm wastes and their BOD in mg per liter: silage, 40,000; piggeries, 10,000; cowstalls, 3,000; dairy produce, 1,800; and poultry processing, 1,000. Many methods of waste treatment have proved uneconomical for the farmer. A compromise is minimal partial treatment to consolidate solid material, aeration, and storage in tanks or lagoons. After six months storage, the waste can be land applied. One Berkshire pig farmer used a centrifuge to separate the solids, sprayed the aerated effluent on land, and sold the dry wastes as fertilizer. (Cassar-FRC)
W82-02039

THE SEWERAGE POLICY OF THAMES WATER,
Thames Water Authority (England).
For primary bibliographic entry see Field 6E.
W82-02040

POLLUTION SOLUTIONS--THE WIRE DRAWING INDUSTRY.
Effluent and Water Treatment Journal, Vol 20, No 6, p 299, 301, 303, June, 1980. 1 Fig, 2 Tab.

Descriptors: *Wire industry, *Heavy metals, *Sedipac clarifier, Wastewater treatment, Metal finishing industry, Industrial wastewater, Effluent standards, Metals, Clarifiers.

The Sedipac clarifier, a high performance tilted tube separation system, is used in the Tinsley Wire (Sheffield) Limited plant for removing metal hydroxides from neutralized mixed effluent. The automatically monitored and controlled system operates at surface loadings of 6-7 cu m per sq m per hour. A mixing tank allows for buffering in case of a highly polluted flow. Sludge is discharged to a thickening and holding tank for subsequent filtration. Since the plant's startup early in 1980, 92% of the total effluent volume has conformed to river discharge standards. It is expected that 99% compliance will be reached after the staff gains more experience. The raw untreated rinsewater contains (in ppm) 734 Fe, 112 Zn, 5 Cu, 39 Pb, 1 Cd, and 45 N. Treated effluent mean levels are well below consent levels. Only the maximum Cu and Pb concentrations slightly exceeded standards on occasion. (Cassar-FRC)
W82-02041

DEVELOPMENTS IN INSTRUMENTATION AND AUTOMATION IN SEWAGE TREATMENT,

Thames Water Authority, London (England). Metropolitan Public Health Div.
R. A. R. Drake, and H. R. S. Page.
Water Pollution Control, Vol 80, No 2, p 231-242, 1981. 21 Ref.

Descriptors: *Wastewater treatment, *Automation, Planning, Water treatment facilities, Operation, Management decisions, Computers. Design criteria.

The strategy for development and implementation of automation in sewage treatment facilities should be coordinated and operating guidelines established for those who are responsible for designing and specifying control systems. The reliability of instrumentation, sensors and control systems is a vital factor, and should be given additional attention in system design. Optimization of treatment processes, quality control, energy savings and better use of existing facilities will become increasingly important as improvements in these areas are made by the correct use of automation. Significant advances have been made in recent years on instrumentation for measurement of flow, sludge blanket level, dissolved oxygen and filtrability. Adequate preventive maintenance is necessary to prevent sensors from being damaged by prolonged exposure to sewage. Specific applications of automation in British water treatment plants are presented. Persistent impediments to complete wastewater treatment plant automation are the lack of a raw influent quality sensor, insufficient sensor reliability, and need for better understanding of sewage treatment processes. (Baker-FRC)
W82-02043

TECHNICAL AND ECONOMIC IMPLICATIONS OF INSTALLING AN INDUSTRIAL WASTE-WATER PRETREATMENT PLANT,
Environmental Control Consultancy Services Ltd., London (England).
D. Anderson.
Water Pollution Control, Vol 80, No 2, p 292-305, 1981. 6 Fig, 7 Tab, 9 Ref.

Descriptors: *Wastewater treatment, *Design criteria, Industrial wastes, Economic aspects, Dye industry wastes, Yorkshire Water Authority, *Great Britain, *Wastewater facilities.

Technical and financial problems that face industry in regard to meeting the standards and limitations imposed by regulatory bodies in installing an industrial wastewater pretreatment plant are described. The system discussed was for a medium-sized multi-product dyestuffs company, discharging 4.5 tcmd of wastewater. The effluent had an average pH value of 1.5 and could produce 100-150 tons/week of neutralized sludge. The most difficult technical problem was to remove, to acceptable levels, various metals used in the company's processes. Methods of treatment included precipitation, precipitate flotation, cementation, liquid-liquid extraction, adsorption, ion-exchange, electrolysis, evaporative distillation and electrodialysis. A comprehensive laboratory experimentation program was begun, encompassing both flotation and precipitation techniques. The results indicated that satisfactory reductions could be achieved, but that equipment availability and the pressing time schedules dictated that a precipitation process should be employed. The development work indicated that a stepped precipitation process was desirable and that to ensure efficient removal of metals a minimum total retention period of 2.5 hr was mandatory within the reactors, and a similar time within the thickener. Sludge dewatering was accomplished using one rotary vacuum filter plus one filter press of the variable chamber type. Capital and operating costs are noted. (Baker-FRC)
W82-02044

KINETICS AND DIFFUSION PROCESSES IN COLOUR REMOVAL FROM EFFLUENT USING WOOD AS AN ADSORBENT,
Queen's Univ., Belfast (Northern Ireland). Dept. of Industrial Chemistry.
G. McKay, and V. J. P. Poots.
Journal of Chemical Technology and Biotechnology, Vol 30, No 6, p 279-292, 1980. 7 Fig, 4 Tab, 19 Ref.

Descriptors: *Color removal, *Wood, *Dyes, Wastewater treatment, Adsorption, Sawdust, Activated carbon, Diffusion coefficients, Boundary layers, *Textile mill wastes, Industrial wastewater.

The adsorption of a basic dye, Astrazone Blue, and an acidic dye, Telon Blue, on sawdust made from Sitka spruce, Picea sitchensis, was studied. The process was controlled by intraparticle diffusion, except for some boundary layer resistance in the early stages of adsorption. The activation energies for adsorption of Astrazone Blue and Telon Blue on the sawdust were 16.8 kJ per mole and 9.6 kJ per mole, respectively. Diffusion coefficients were 6 to 18 times 10 to the minus 13th power sq cm per sec for Astrazone Blue at 18 degrees C and 3 to 8 times 10 to the minus 13th power sq cm per sec for Telon Blue at 18 degrees C. This variation in diffusivities is attributed to boundary layer effects. Agitation increased the rate of color removal. An increase in temperature produced an increase in the rate of adsorption for both dyes in the early stages. After that, the rate increased with the basic dye and decreased with the acid dye. Costs for removing Telon Blue with sawdust were 1.5% that of activated carbon; Astrazone Blue, 8.2%. (Cassar-FRC)
W82-02047

PRODUCTION OF AROMATIC ACIDS DURING ANAEROBIC DIGESTION OF CITRUS PEEL,
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Food Research.
A. G. Lane.
Journal of Chemical Technology and Biotechnology, Vol 30, No 6, p 345-350, 1980. 2 Tab, 11 Ref.

Descriptors: *Citrus fruits, *Anaerobic digestion, *Organic acids, Biological treatment, Food processing wastes, Aromatic compounds, Organic compounds, Acids, Benzoic acid, Phenylacetic acid, Phenylpropionic acid, Limonene, *Wastewater treatment, Toxicity, Flavonoids, Coumarins.

The aromatic acids, benzoic, phenylacetic, and phenylpropionic, were found in liquors after failure of the anaerobic digestion of commercially prepared citrus oils, distilled citrus oils, limonene, and the nonvolatile residue of lemon oils. The aromatic acids themselves were not toxic to the digestion process. When they were added to feedstocks, they degraded rapidly. Materials as yet unidentified were responsible for the toxicity. Experiments showed that phenylpropionic acid was probably derived from flavonoids and benzoic acid, and phenylacetic acid from courmarins. Hand-prepared orange albedo with 2 mg oil per 100 g was not toxic to the digestion process during 21 days of study; no aromatic acids were detected. (Cassar-FRC)
W82-02049

A MECHANISTIC MODEL OF A PACKED-BED ELECTRODE CELL TO REMOVE METAL IONS FROM DILUTE EFFLUENT SOLUTIONS,
University of the Witwatersrand, Johannesburg (South Africa). Dept. of Chemical Engineering.
A. W. Bryson, and K. A. Dardis.
Journal of Chemical Technology and Biotechnology, Vol 30, No 1, p 14-19, 1980. 2 Fig, 1 Tab, 13 Ref.

Descriptors: *Cathodes, *Metal-finishing wastes, *Packed beds, Wastewater treatment, Industrial wastewater, Electrodes, Nickel, Chromium, Zinc, Copper, Electroplating.

A pilot plant for treating electroplating waste effluents was designed with the aid or a mathematical model of a porous cathode cell. Copper, zinc, nickel, and chromium were reduced by greater than 90% (influents 13.5-37.5 mg per cu dm, effluents 0.9-1.5 mg per cu dm) using acid copper wash and zinc cyanide wash (flow rate 360 cu dm per hour) and nickel and chromium wash (flow rate 180 cu dm per hour). Dimensions of the cell's packed section were 1.9 m x 0.35 m x 5 mm. Packing was crushed graphite, size range 1.2-1.7 mm. (Cassar-FRC)
W82-02050

5E. Ultimate Disposal Of Wastes

GEOLOGIC AND HYDROLOGIC IMPLICATIONS OF HAZARDOUS WASTES MANAGEMENT RULES ON SITING IN NORTH CAROLINA,
Ebasco Services, Inc., Greensboro, NC.
G. L. Bain, and P. Hansen.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 267-275, August, 1981. 7 Fig, 18 Ref.

Descriptors: *Land disposal, *Waste management, *Waste storage, Waste disposal, Environmental effects, Model studies, Mathematical studies, Groundwater movement, Geohydrology, *North Carolina, Economic aspects, *Site selection.

Having to predict the ultimate fate of disposed wastes may make site evaluation for waste disposal expensive. To accurately predict the effects of sorption, mechanical dispersion, ionic diffusion, and osmosis on the concentration of waste species, good groundwater flow models and simulations of solute transport are needed. The ideal disposal zone should also contain flat-lying, homogeneous, non-fractured silt-stone, clay or silty sandstone situated well above the water table. Most waste disposal sites in North Carolina do not meet these criteria. Under the Resource Conservation and Recovery Act, federal and state laws may enforce the use of presently accepted safe disposal practices and monitoring techniques. The financial and environmental impact of these regulations on the generation of wastes will depend on the extent to which they address geohydrologic complexities. (Geiger-FRC)
W82-01630

PERSPECTIVE ON MANAGEMENT AND DISPOSAL OF HAZARDOUS WASTES,
North Carolina State Univ. at Raleigh. Dept. of Marine Earth and Atmospheric Sciences.
H. S. Brown, and H. E. LeGrand.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 231-235, August, 1981. 1 Fig, 2 Ref.

Descriptors: *Hazardous materials, *Waste disposal, *Graphical analysis, *Groundwater pollution, Waste management, Model studies, Site selection, Geohydrology, Hydrologic aspects, Water pollution effects, Graphical methods, Mathematical studies.

The overall problem of managing and disposing of hazardous wastes is compounded by the polarized ideas of regulatory officials, geologists and hydrologists, design engineers, and owners and operators of waste management facilities. Added complifications arise from the negative views held by various sectors of the public. A standardized system for surveying waste disposal sites and their contaminant input is sought that can use either in-depth derived data or general site data. The system should include concise descriptions and evaluations of all existing and planned hazardous waste sites. The standardized evaluations should identify the hydrogeological characteristics of a site on a scale of various aquifer sensitivities to contamination spread. A scale of severity of contamination identifies a particular waste's toxicity, concentration, volume and persistence, four parameters which are integrated into a graphical matrix showing the potential for groundwater pollution. This sytem allows for the development of acceptance or rejection standards based on the natural setting and on engineering modifications to the site. (Geiger-FRC)
W82-01635

ROLE OF THE GEOTECHNICAL CONSULTANT IN SITING SUITABLE AREAS FOR HAZARDOUS WASTE DISPOSAL,
Soil and Material Engineers, Inc., Raleigh, NC.
E. W. Glover, Jr.

Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 227-230, August, 1981.

Descriptors: *Waste disposal, *Hazardous materials, *Site selection, *Geohydrology, Hydrologic aspects, Systems analysis, Leaching, Waste management, Land disposal, Waste dumps, Engineering geology, Leachates, Solid wastes.

The geotechnical consultant can be of valuable assistance in choosing a hazardous waste disposal site. The consultant may suggest areas more appropriate to disposal and carry out preliminary site evaluations based upon the available literature. Utilizing this data, the consultant may rank the sites in order of preferences to select the best site and develop plans for test borings and for field and laboratory monitoring of well installations. When the field work is completed, engineering studies are conducted to evaluate seepage from the storage area, the potential for leaching, the appropriate collection system for leachates, and flood level designs. The final report is considered as part of the permit documents to support licensing of the site as a proper disposal area for hazardous wastes. (Geiger-FRC)
W82-01636

FLOW CALCULATIONS FOR HOUSEHOLD EFFLUENT DISPOSAL IN ELEVATED SAND MOUNDS,
Environmental Protection Agency, Ann Arbor, MI.
T. D. Mott, D. D. Fritton, and G. W. Petersen.
Journal of Environmental Quality, Vol 10, No 3, p 311-314, July-September, 1981. 4 Fig, 15 Ref. OWRT-B-098-PA(4).

Descriptors: Flow, *Mathematical equations, *Soil absorption capacity, *Land disposal, *Wastewater disposal, Domestic wastes, Sand, *Sand mounds, Hydraulic conductivity, Design flow, Rural areas, Household wastewater.

On-site disposal and renovation of household wastewaters present serious problems in many urban fringe and rural areas. About half of all on-site systems fail to perform satisfactorily over their entire design life of 15 to 20 years. Elevated sand mound disposal systems have been used in Pennsylvania, since the soil is generally not suitable for conventional on-site effluent disposal systems. However, about 40 percent of these systems malfunctioned in less than 5 years. Since the malfunctions were associated with observations of surface discharges of effluent, this study investigated the ability of the soil to transmit effluent from an elevated sand mound to the groundwater system. It was assumed that both the infiltration surfaces and the groundwater system were able to accept the effluent. The flow calculation method used was predicated upon separation of the effluent flow into horizontal and vertical flow components. Darcy's law written in cylindrical coordinates was used to calculate horizontal flow. Vertical flow was calculated, assuming that flow was limited by a single, slowly permeable layer of known thickness. The calculations demonstrate that the lateral plus vertical flow capacity of the soil must exceed the anticipated effluent input if the disposal system is to perform satisfactorily. Data requirements for evaluation of the suitability of a specific site for disposal of household wastewater using a mound system are identified. Calculations made using data representative of many of the failing mound systems in Pennsylvania indicate that these failures result from the inadequacy of the combined lateral and vertical flow capability. (Carroll-FRC)
W82-01660

INDUSTRIAL WASTE DUMPING AT DEEP-WATER SITES IN THE GULF OF MEXICO,
National Ocean Survey, Rockville, MD. Ocean Dumping and Monitoring Div.
E. R. Meyer, and C. E. Warsh.
In: Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX), Key Biscayne, Florida, 30 September - 5 October 1979, Volume IIC, May, 1981. p 211-239, 2 Fig, 6 Tab, 29 Ref. National Oceanic and Atmospheric Administration, Miami, Florida.

Descriptors: *Industrial wastes, *Ocean dumping, *Sludge disposal, *Environmental effects, Biological wastewater treatment, Chemical wastes, Organic compounds, Microorganisms, *Gulf of Mexico.

About 10 different kinds of industrial wastes were dumped at two deepwater sites in the Gulf of Mexico between 1973 and 1978. The Western Gulf site, south of Galveston, Texas, was used during the study exclusively by the Shell Chemical Company of Deer Park, Texas. The material dumped at the site was a biological sludge consisting of living and dead microorganisms (primarily bacteria and protozoans), inorganic salts, and a large variety of organic compounds in suspension and solution, produced by a biological waste water treatment system. Results of the dump site study program indicate that the overall environmental consequences of discharging the biosludge produced by the Shell Chemical Company plant were negligible. Both the liquid and solid portions of the waste samples examined during the program had deleterious effects upon all test species during laboratory tolerance experiments when the wastes were of sufficiently elevated concentration. The results of waste tracking experiments indicated that waste concentrations of that magnitude probably do not persist in the field more than a few hours during dumping episodes. The wastes, at low concentrations, actually seemed to increase rates of growth in green algae species and reproduction in the amphipod Amphithoe valida. In view of the depauperate nature of the dumping area, the actual long-term biological impacts of dumping there appear to have been minimal. (Moore-SRC)
W82-01903

CENTRIFUGAL DEWATERING,
Pennwalt Ltd. (England).
J. E. Remfry.
Water and Waste Treatment, Vol 24, No 9, p 23-24, September, 1981. 4 Fig, 1 Tab.

Descriptors: *Sludge drying, *Centrifugation, *Sludge disposal, Sludge cake, Alum sludge, Performance evaluation, Costs, *United Kingdom.

Municipal and industrial effluent treatment sludges can be dewatered using the decanting centrifuge. Mechanical dewatering has many advantages, including the avoidance of large lagoons and the production of a readily disposable cake. The centrifuge can treat all types of sludge and can be made mobile and moved from plant to plant. Also, installation is compact and operation is non-labor intensive. Performance figures are presented for the main types of sludge that are centrifuged: alum, ferric, and lime. Characteristics of the raw water, especially turbidity, influence the nature of the sludge produced. There are now centrifugal sludge dewatering installations at almost all of the British water authority areas. (Small-FRC)
W82-01912

A TEST UTILIZING SEDIMENT TRAPS, SURVEY RODS, AND RADIOGRAPHS TO MONITOR SEDIMENT ACCUMULATION FROM A DREDGING DISPOSAL OPERATION,
NALCO Environmental Sciences, Northbrook, IL.
For primary bibliographic entry see Field 7B.
W82-01950

GEOLOGIC ASPECTS OF WASTE DISPOSAL SITE EVALUATIONS,
Law Engineering Testing Co., Marietta, GA.
D. G. Miller, Jr., and W. J. Alexander.
Bulletin of the Association of Engineering Geologists, Vol 18, No 3, p 245-251, August, 1981. 3 Fig, 9 Ref.

Descriptors: *Waste disposal, *Geohydrologic units, *Groundwater hydrology, *Fate of pollutants, Land disposal, Site selection, Hydrologic aspects, Waste management, Hydrologic systems, Geomorphology, Path of pollutants, Groundwater movement, Geohydrology, Planning.

In response to increasingly stringent regulatory standards and variations in site-specific guidelines, the evaluation of waste disposal sites is becoming more comprehensive. Since greater attention is being given to the fate of pollutants at each site, studies of groundwater movement and the effects of various subsurface materials on the dispersal of contaminants are required. Some relevant hydrologic conditions and site-specific variations are reviewed for Coastal Plain, Piedmont, Valley and Ridge areas of the eastern United States. Multiphased evaluations of waste disposal sites are practical when such diverse physiographic sections are considered. For existing waste disposal facilities, the initial phase of evaluation combines knowledge of area geology and operational information. Subsequent studies include a detailed assessment of localized hydrogeologic units and the availability and suitability of existing soil and rock formations as construction materials. In siting new facilities, the most suitable geologic area of the province is initially defined. (Geiger-FRC)
W82-02011

WASTE DISPOSAL--CHOOSING AND LICENSING SITE,
Severn Trent Water Authority, Birmingham (England).
For primary bibliographic entry see Field 5G.
W82-02035

POLLUTION FROM FARMS,
Thames Water Authority, London (England).
For primary bibliographic entry see Field 5D.
W82-02039

5F. Water Treatment and Quality Alteration

PLANNING WITH GREAT UNCERTAINTY: A REVIEW AND CASE STUDY OF THE SAFE DRINKING WATER CONTROVERSY,
Livingston Coll., New Brunswick, NJ. Dept. of Urban Studies.
For primary bibliographic entry see Field 5A.
W82-01606

COPPER(II)- AND CADMIUM(II)-BINDING ABILITIES OF SOME NEW HAMPSHIRE FRESHWATERS DETERMINED BY DIALYSIS TITRATION,
New Hampshire Univ., Durham. Dept. of Chemistry.
R. E. Truitt, and J. H. Weber.
Environmental Science and Technology, Vol 15, No 10, p 1204-1208, October, 1981. 1 Fig, 2 Tab, 21 Ref.

Descriptors: *Adsorption, Inorganic compounds, *Heavy metals, Water quality control, Chemical properties, Binders, Separation techniques, *Copper, *Cadmium, Cations, Drinking water, Ions, Potable water, Pollutants, Water supply, Water quality management, Anions, New Hampshire.

Processes such as adsorption to particulates, complexation by naturally occurring ligands, and precipitation all act to regulate the aquatic levels of free heavy metal ions which may be toxic to aquatic life and to man. The ability of seven New Hampshire freshwater samples to sequester divalent copper and cadmium ions was studied by a dialysis titration technique in laboratory tests. Five samples, three from rivers and two from reservoirs, were representative of local drinking water supplies. Pond and swamp samples were included for comparison. The potential binding levels (PBL) were calculated as indicators of the copper- and cadmium-binding properties of the water samples. Copper cation PBL values ranged from 1.1 to 15.1 micromolar, while cadmium cation PBL values ranged from 0.0 to 9.7 micromolar. Alkalinity, pH, dissolved organic carbon, hardness, conductance and UV absorbance were correlated with copper ion and cadmium ion PBL values in six of the seven samples analyzed. Copper ion PBL values were significantly correlated with the inorganic

properties, but not the organic properties of the samples at the 90% confidence level. Nonunity slopes of copper experiments suggested complexing of copper ions with the inorganic anionic constituents of the water samples. No significant trends at the 90% confidence level were found for the cadmium ion PBL values. (Geiger-FRC)
W82-01632

THE REMOVAL OF ORGANIC MATTER FROM SURFACE WATER SUPPLIES BY ANION EXCHANGE RESINS,
C. A. Macko.
PhD Thesis, 1980. 227 p, 66 Fig, 30 Tab, 102 Ref, Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-19545.

Descriptors: *Water pollution, *Water quality control, *Organic matter, *Anion exchange, Pollutant identification, Surface waters, Resins, *Mississippi River, Heavy metals, Amberlite IRA-904.

This investigation focused on the nature of naturally occurring organics and their removal from water supplies by the strong base anion exchange resin, Amberlite IRA-904. Mississippi River water was ultrafiltered to determine the molecular size distribution of the organic carbon and for anion exchange removal studies. Results indicated that dissolved organic carbon (DOC) concentrations in the Mississippi River varied seasonally. Anion exchange of river water involves a multicomponent system in which competition plays a major role. All experiments were done with the resin originally in the chloride form and at the natural pH of the river water. Regeneration of columns was done with 1.0 M NaCl with DOC recovery at 77-95% with 3 empty bed volumes of regenerant. Besides organics, the regenerant was found to contain significant quantities of trace inorganics and metals indicating uptake of these ions by the resins. Fe, Ca, B, and Zn were found in concentrations of 100-1000 times their value in an equal volume of river water. Al, P, Mn and Ni were found to be concentrated to a lesser extent. Amberlite IRA-904 showed significant removal of high molecular weight organics from surface water supplies, producing an effluent of as low as 0.5 mg/L DOC (bed depth 31 cm). Removal and subsequent recovery of trace metals in the regenerate brine indicated an additional advantage to the use of resins in water treatment. (Sinha-OEIS)
W82-01697

DRINKING WATER AND ITS TREATMENT: AN INTERVIEW WITH PROFESSOR SONTHEIMER,
S. Miller.
Environmental Science and Technology, Vol 14, No 5, p 510-512, 514, May, 1980.

Descriptors: *Drinking water, *Water treatment, *Germany, Chlorination, Ozonation, Ozone, Chlorine, Wells, Rivers, Percolation, Groundwater.

In Germany 50% of the drinking water supplies come from surface water, but practically all river waterworks use some sort of ground filtration. Water is drawn from wells along the rivers at distances from 50 to 100 meters so that the retention time in the ground is from 30 to 100 days. This practice reduces the organics concentration in the water about 75% from what was originally present in the raw river water. Thus activated carbon can be used in the treatment train with a much greater efficiency than would otherwise be possible. Biological treatment is used extensively because of its cost effectiveness. Slow sand filters are used where river bank filtration is not possible. Breakpoint chlorination is not used in Germany today; instead, ammonia is removed biological. Ozone is used for special purposes including enhancement of biological treatment. A small dose of ozone improves flocculation in difficult conditions. While consideration is being given to establishing guidelines for permissible trihalomethane concentrations in drinking water, such guidelines are not being considered for Germany, as chlorination is not used in water treatment there. (Baker-FRC)
W82-01728

EFFECT OF REAGENT MIXING RATE ON ADSORPTION PROCESS FOR AM-FE2O3.H2O,
Stanford Univ., CA. Dept. of Civil Engineering.
A. R. Appleton, Jr., and J. O. Leckie.
Environmental Science and Technology, Vol 15, No 11, p 1383-1386, November, 1981. 5 Fig, 7 Ref.

Descriptors: *Mixing, *Coagulation, *Heavy metals, *Adsorption, Metals, Cadmium, Water treatment facilities, Flocculation, Ferric chloride, Wastewater treatment, Water treatment.

There was no significant variation in physicochemical surface characteristics in freshly precipitated or 1 hour aged amorphous Fe2O3(H2O) coagulant in a well-mixed system with mean residence times from 5 to 30 sec. Cd(2+) at a trace level was used as a diagnostic tool. The removal of trace metals by adsorption onto Fe(3+) flocs in water or wastewater treatment systems is not affected by mixing conditions as long as complete dispersion of the flocculant takes place within 30 sec. (Cassar-FRC)
W82-01799

ALUMINUM SULFATE TREATMENT: SHORT-TERM EFFECT ON COMPLEX PHOSPHORUS COMPOUNDS IN A EUTROPHIC LAKE,
Michigan State Univ., Hickory Corners, Kellogg Biological Station.
D. A. Francko, and R. T. Heath.
Hydrobiologia, Vol 78, No 2, p 125-128, March, 1981. 2 Fig, 11 Ref.

Descriptors: *Eutrophic lakes, *Phosphorus compounds, *Alum, Hypolimnion, *Water treatment, Orthophosphates, Lake restoration, Epilimnion, West Twin Lake, Ohio, Nutrients, Phosphorus removal, Process efficiency.

Previous studies have demonstrated that hypolimnetic application of liquid aluminum sulfate (alum) may accelerate lake reclamation by removing phosphorus from the water column and by sealing anoxic sediments to reduce the release of nutrients. This study was designed to investigate the effectiveness of alum applications to the hypolimnion in removing various complex phosphorus compounds occurring in eutrophic lakes. These complex phosphorus compounds include phosphomonoesters, polyphosphates, and ultraviolet-sensitive phosphorus compounds. Alum was applied to the hypolimnion of West Twin Lakes, a culturally eutrophic hardwater lake in northeastern Ohio. Orthophosphate was effectively removed from the lake by this treatment, but complex phosphorus compounds were not. Potentially available phosphomonoesters comprised a considerable proportion of the complex phosphorus fraction in the lake water both before and after the alum treatment. Most of the complex phosphorus compounds remaining in the lake water after the alum treatment were capable of releasing orthophosphate on treatment with alkaline phosphatase. These results indicate that aluminum sulfate treatment may be ineffective in removing all biologically available phosphate compounds from the lake water. Further research is required to determine the overall applicability of alum treatment as a nutrient inactivation method. (Carroll-FRC)
W82-01833

TACKLING THE NITRATE PROBLEM.
Effluent and Water Treatment Journal, Vol 21, No 7, p 313, July, 1981.

Descriptors: *Water treatment, *Nitrates, Ion exchange, Water treatment facilities, Municipal water, Industrial water, Food processing industry, Water quality, *Nitrate removal.

Nitrate removal units are available for the removal of high nitrate levels from public water supplies. These high nitrate levels are of particular concern to the flood processing industry. Nitrate concentrations in excess of 1 ppm have a depolarizing effect on the half-cell corrosion reaction, resulting in accelerated deterioration of food cans. High nitrate concentration can also lead to the staining of cans and the discoloration of certain meats. The automatic nitrate removal units employed in the industry operate at flow rates from as low as 30 liters/hour up to 10,000 liters per hour, and will reduce nitrate levels to between 5 and 10 mg/liter. The units operate by absorbing nitrates on to an ion exchange resin, which releases an equivalent quantity of chloride. A counterflow regeneration ion exchange technique which effectively halves the salt consumption during regenerations and produces significant process cost savings has been developed for large scale operations. In a major cannery complex with a throughput of 5,000 gal per hour, nitrate nitrogen levels were reduced from 10-12 to 0.2 ppm. Another successful operation involves the treatment of nitrate bearing borehole water. However, nitrate removal from municipal water, a costly process, appears to be a long way from implementation. (Baker-FRC)
W82-01874

SUBSTRATE FLUX INTO BIOFILMS OF ANY THICKNESS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W82-01964

A NATIONAL SURVEY OF TRI(HALOALKYL)-, TRIALKYL-, AND TRIARYLPHOSPHATES IN CANADIAN DRINKING WATER,
Environmental Health Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W82-01989

EXPERIENCE WITH LAKE AND RESERVOIR RESTORATION TECHNIQUES IN THE GERMAN DEMOCRATIC REPUBLIC,
Institut fuer Wasserwirtschaft, Berlin (German D.R.).
For primary bibliographic entry see Field 2H.
W82-02054

DISINFECTION OF DRINKING WATER IN DEVELOPING COUNTRIES,
Omnium de Traitment et de Valorisation, Courbevoie (France). Water Dept.
J. Sibony.
Aqua, No 5, p 21-27, 1981. 2 Fig, 6 Tab, 15 Ref.

Descriptors: *Potable water, *Disinfection, Chlorination, Ozonation, Drinking water, Water quality, Human diseases, Chlorine, Ozone, Microorganisms, *Developing countries.

Various means of achieving disinfection of drinking water in developing countries are reviewed. In many outbreaks of human disease, drinking water has carried the pathogenic agent. When water has been treated and then filtered, the effectiveness of disinfection will directly depend on the quality of clarification. In hot countries, treatment without filtration will always lead to suspicions that the water is carrying organisms that do not respond significantly to the normal disinfectants used. The effectiveness of chlorination is affected by the water acidity, presence of ammonia, temperature levels, and retention time. The presence of dissolved organic matter in the water to be disinfected is harmful in several ways. First, more chlorine will be consumed. Second, the treated water will taste of chlorine due to the flavor of the organochlorinated compounds. As a means of control to test the amount of total chlorine present, the orthotolidine test can be used. However, the preferable method is to use the diethyl-p-phenylene-diamine test, which measures only the free chlorine. A level of free chlorine equal to 0.1 ppm maintained throughout the network provides an excellent guarantee that the water is properly disinfected against bacteria, provided that the water has been cleared of suspended solids. The benefits of ozone disinfection over and above chlorination are considered. The preparation of the water for ozonation, contact time and concentration, significance of pH, temperature, ammonia, and means of control are all considered. Use of post-chlorination after ozone disinfection is briefly considered. (Baker-FRC)
W82-02091

5G. Water Quality Control

PROTECTING VIRGINIA'S WATERWAYS,
J. Josephson.
Environmental Science and Technology, Vol 15, No 10, p 1125-1127, October, 1981. 1 Fig, 2 Tab.

Descriptors: *Water quality control, *Water pollution prevention, *Pesticide residues, *Kepone, Water pollution treatment, Waste water treatment, Water pollution control, Heavy metals, Chlorine, Pesticides, Fluvial sediments, Environmental effects, Dredging, *James River, Virginia, Shellfish farming.

The Virginia Environmental Endowment engaged the National Wildlife Federation to study the Kepone incident, which caused extensive pollution of the James River, and examine strategies to prevent future episodes of environmental pollution by toxic substances. The Federation recommended careful screening of discharges from publically owned treatment works through the National Pollutant Discharge Elimination system and by application of the Cairns matrix. The federation also recommended new dredging procedures to minimize disturbances of Kepone-containing sediments. Highest priority for sediment cleanup should be given to areas for shellfish farming and public water supply sources. Screening for heavy metals, chlorine and chloramines was suggested along with research to identify effective, nonhalogenated waste water treatment processes. More sophisticated chemical residue detection methods for water and living tissue was called for and more research on depuration mechanisms was suggested. Problems in the implementation of the federations report and reaction to its findings are discussed. (Geiger-FRC)
W82-01608

PUBLIC OPINION AND INTEREST GROUP POSITIONS ON CHESAPEAKE BAY ISSUES: IMPLICATIONS FOR RESOURCE MANAGEMENT,
Maryland Technical Advisory Service, College Park.
For primary bibliographic entry see Field 6B.
W82-01642

DESTRATIFICATION AND REAERATION AS TOOLS FOR IN-LAKE MANAGEMENT,
Salford Univ. (England). Dept. of Civil Engineering.
B. Henderson-Sellers.
Water SA, Vol 7, No 3, p 185-189, July, 1981. 1 Fig, 2 Tab, 19 Ref.

Descriptors: *Destratification, *Lake restoration, *Aeration, Aerators, Mixing, Rehabilitation, Lakes, Reservoirs, Reservoir operation, *Thermal stratification prevention, Evaporation, *South Africa.

Methods to prevent or destroy thermal stratification and/or to aerate lake water are described. Many devices used for the destratification of reservoirs or lakes can also be used for hypolimnetic reaeration, including diffusers, bubble guns, and Helixors. No theoretical basis has been developed for most of these methods and devices. The Helixor is based on small bubbles kept in contact with the water for comparatively long periods by circulation around a helix as the bubbles rise. Oxygen is dissolved in the water in the body of the Helixor. The total volume of water moved by the Helixor per day in one application was 1% of the total volume of the reservoir. Helixor models are presented which simulate destratification. Helixors are best at preventing stratification. In addition to aiding destratification, the surface temperature is reduced in summer, which results in a decrease in the rate of evaporation. In an area where the annual evaporation is 1800 mm per year, this reduced evaporation yields a total water savings of about 50 mm. Trial runs for these devices are planned in South Africa. (Small-FRC)
W82-01648

BIOLOGICAL AND PHYSICAL INVESTIGATIONS OF BODIES OF WATER BENEATH DENSE WATER HYACINTH POPULATIONS BEFORE AND AFTER CHEMICAL TREATMENT,
Florida Univ., Gainesville. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-01678

A LIMNOLOGICAL INVESTIGATION OF A TROPICAL FRESH-WATER ECOSYSTEM: THE BELIZE RIVER, BELIZE, CENTRAL AMERICA,
Western Michigan Univ., Kalamazoo.
V. J. B. Gonzalez.
PhD Dissertation, 1980. 221 p, 11 Fig, 20 Tab, 137 Ref, 6 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-25554.

Descriptors: *Water quality control, *Ecosystems, Freshwater, Rivers, *Belize, Central America, River ecology.

At present the water supply system for the country of Belize is from both groundwater and surface water sources. With increasing demands being placed on the water resources of Belize, adequate management programs for such resources must be developed. The study described herein aims at approaching a comprehensive understanding of the ecosystem of the Belize River. To avoid a severe degradation of the water quality in the Belize River, a continuing effort should be made to assess the ecological relationships that exist within it. Bacterial counts, chemical analyses, biota assessments, and other parameters that are necessary in the determination of water quality should be the major aspects of the continuing effort. The information so gained will provide the fundamental environmental data that are necessary for the development and reassessment of management programs. Evidence gathered in this investigation supports the conclusion that the major portion of the Belize River is currently of a high quality. It is recommended that every effort be made to limit the pollution of the river in the regions of Stations 1 and 2 where the water is already of low quality. Adequate sewage treatment and specific legislation governing the dumping of industrial waters need to be implemented. It is also recommended that continuous monitoring of the river be undertaken. Finally, the need to protect waterways should be brought to the attention of the Belizean public. This task may be accomplished primarily through the educational system. (Sinha-OEIS)
W82-01682

PETROLEUM DEGRADATION BY NATURALLY OCCURRING POPULATIONS OF MARINE BACTERIA FROM MIDDLE ATLANTIC OUTER CONTINENTAL SHELF WATERS,
College of William and Mary, Williamsburg, VA. Dept. of Marine Science.
A. E. Maccubbin.
PhD Dissertation, 1980. 169 p, 28 Fig, 13 Tab, 96 Ref, 11 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-03585.

Descriptors: *Bacteria, *Microbial degradation, *Biodegradation, *Oil pollution, Water pollution, Petroleum, Oil industry, Oil spills, Pseudomonas, Middle Atlantic Ocean, Hydrocarbons.

Bacterial populations indigenous to surface (1 m) waters of the Middle Atlantic Outer Continental Shelf were sampled at seasonal intervals to determine the abundance and distribution of petroleum-degrading (HC) and 'total' heterotrophic (HET) bacteria. Simultaneously, unweathered South Louisiana crude oil (SLCO) was added to aliquots of surface water samples to evaluate rates and patterns of degradation of hydrocarbon. Degradation was studied using selected nutrient and temperature regimes in both closed flask and prototype 'open' or continuous dilutions systems. HET bacterial levels generally decreased with distance from land. HC bacteria were most abundant in the coastal boundary layer. Changes in values of HC/HET often were not directly related to the abundance of petroleum-degrading bacteria. In closed flasks the composition of bacterial populations changed slightly in response to SLCO addition; Pseudomonas predominated after 48 days. Pseudomonas isolates exhibited the greatest ability for petroleum degradation in pure culture. Degradation of SLCO in closed flasks characteristically resulted in removal of n-alkanes and selected aromatics at rates related to season, sampling location, and nutrient regime. Aromatic compounds were often removed concomitantly with n-alkanes. Although maximum rates of degradation were observed at 15 degrees C using coastal water inocula and inorganic nutrient enrichment, all shelf waters sampled contained bacteria capable of petroleum degradation. (Sinha-OEIS)
W82-01683

THE EFFECTS OF SECONDARY SEWAGE EFFLUENT ON THE WATER QUALITY, NUTRIENT CYCLES AND MASS BALANCES, AND ACCUMULATION OF SOIL ORGANIC MATTER IN CYPRESS DOMES,
Florida Univ., Gainesville.
F. E. Dierberg.
PhD Dissertation, 1980. 324 p, 67 Fig, 38 Tab, 267 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-05570.

Descriptors: *Water quality, *Nutrients, *Organic matter, Sewage effluents, Nitrogen, Wetlands, Tertiary treatment, *Florida, *Cypress domes, Secondary sewage.

The capability of cypress domes to act as efficient nutrient traps has been demonstrated for a natural and sewage-enriched cypress dome. Mass balance models indicated that 87% of the nitrogen and 92% of the phosphorus loadings were retained within a cypress dome receiving secondary sewage effluent, removal efficiencies that are among the highest reported for any wetland ecosystem receiving treated sewage. Thus, cypress domes seem to be effective natural tertiary treatment systems. Field data and laboratory investigations demonstrated that denitrification was a major nitrogen sink in both natural and sewage-enriched domes. Bulk precipitation was the most important factor in supplying new minerals and nutrients (except nitrogen) to the natural cypress dome. Analyses of standing waters of natural and sewage-enriched cypress domes near Gainesville, Florida, over a 4.5-year period showed that discharge of secondary sewage effluent altered the soft, acid water found in natural domes to a neutral, moderately hard condition. Furthermore, the absence of dissolved oxygen, high levels of phosphorus, nitrogen, biochemical oxygen demand, and the presence of hydrogen sulfide mean that treated sewage effluent has a substantial impact on water quality. Water samples from shallow wells, ceramic soil moisture tubes, and laboratory percolation columns indicated that the underlying organic matter and sands were serving as an effective barrier to the transport of sewage pollutants to the shallow aquifer immediately below. (Sinha-OEIS)
W82-01687

REGULATING THE QUALITY OF DRINKING WATER: AN ECONOMIC ANALYSIS OF THE SAFE DRINKING WATER ACT OF 1974,
Wisconsin Univ.-Madison.
R. L. Raucher.
PhD Thesis, 1980. 342, p 22 Fig, 42 Tab, 44 Ref, 6 Append, University Microfilms International, Ann Arbor, MI; Order No GAX 81-05294.

Descriptors: *Economic feasibility, *Water quality control, Regulations, Legislation, Potable water, *Economic analysis, *Drinking water, Safe Drinking Water Act.

The first half of the thesis provides a framework with which to investigate whether or not the market failure associated with imperfect information can justify government intervention in general, and the imposition of regulations such as those embodied in the Safe Drinking Water Act in specific. The second portion of the thesis pertains to the economic impacts of the regulations. It consists mainly of the presentation and analysis of empirical results generated by two microdata simulation models. Nonmodel analyses are also provided, as

are policy recommendations and conclusions. The focus of the study then shifts to the indirect effects of the transfer of funds from water consumers to producers of treatment supplies. The model used to simulate the output, employment, and distributional consequences of interregional trading and production relationships is described, and regional shares of the changes in the level and composition of economic activity are then presented and analyzed. (Sinha-OEIS)
W82-01691

POLLUTION PERMITS AND MARKETS FOR WATER QUALITY,
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 6A.
W82-01699

CONTROLLING RUNOFF FOR LIVESTOCK FEEDLOTS; A STATE OF THE ART,
Science and Education Administration, Lincoln, NE.
C. B. Gilbertson, J. C. Nye, R. N. Clark, and N. P. Swanson.
Agricultural Research Service, Agriculture Information Bulletin Number 441, October, 1981. 21 p, 7 Fig, 1 Tab, 50 Ref.

Descriptors: *Feedlot wastes, *Feedlot runoff, *Livestock, *Water pollution control, Water pollution sources, Rainfall, Storms, Waste characteristics, Design criteria, Irrigation, Land disposal, Evaporation.

Runoff from livestock feedlots is a recognized water pollution source, which is now controlled by the Federal Water Pollution Control Act Amendments. Feedlots are included in the industrial category and are identified as a point source. Runoff resulting from storm events less severe than a 24 hour, 10-year storm must be controlled; in 1983 the limit will be a 24 hour 25-year storm. Feedlot runoff can be estimated from equations relating runoff to storm rainfall and the surface of the lot. In northern latitudes, snow melt must be considered. The chemical and solid constituents of feedlot runoff vary widely, with highest levels of total solids, volatile solids, and chemical oxygen demand being found in snow melt. Designs for runoff control have the following features: diversion of runoff from outside the feedlot area; provision of proper feedlot drainage; use of debris basins; use of detention or holding ponds; and provision of proper techniques for land application. Ultimate disposal of the runoff depends on the local soil, climate and the size of the feedlot. The runoff may be used for irrigation, allowed to evaporate, or be run onto the land. Knowledge of the groundwater is needed before a disposal system is planned, and proper cleaning and maintenance of the facility is essential. (Brambley-SRC)
W82-01769

TYING UP TCE,
Ayres, Lewis, Norris and May, Inc., Ann Arbor, MI.
A. E. Singhal.
Water/Engineering and Management, Vol 128, No 9, p 56, 58, 60, 63, September, 1981. 2 Fig, 3 Tab.

Descriptors: *Organic compounds, *Activated carbon, *Water treatment, *Groundwater pollution, Water pollution control, Separation techniques, Adsorbents, Drinking water, Cost analysis, Pilot plants, Design criteria, Water pollution, Packed beds, Filters, Adsorption, *Trichloroethylene.

A groundwater supply contaminated with trichloroethylene (TCE) was used as a study site to investigate the removal of organic compounds from water. To remove TCE, purging the aquifer, aeration and adsorption were suggested. Carbonaceous or activated carbon adsorption by itself or in conjunction with aeration showed the best potential for meeting EPA drinking water standards. Granular activated carbon (GAC) proved very effective in the removal of TCE in both laboratory and pilot studies. A cost/effectiveness analysis was performed on GAC removal with on-site regeneration, GAC after aeration plus off-site carbon regeneration, and removal by Ambersorb XE-340 following aeration and on-site regeneration of the adsorbent. The latter two TCE removal techniques yielded total annual costs within 1% of each other. Pilot plant studies using Filtrasorb 300 high activity carbon columns were set up to determine design criteria for effective TCE removal. Two contactors in series each providing 8-10 minutes of contact time appeared suitable for meeting the criteria of 20 microg/liter in the effluent. A third backup unit was suggested to allow maintenance and service of the two main units. If a packed bed system is used, pre-filtration minimizes the amount of backwashing of the carbon beds. Design parameters for a treatment system capable of handling a flow of 450 gpm are summarized. (Geiger-FRC)
W82-01866

THE VALUE OF ECOLOGICAL MONITORING IN THE MANAGEMENT OF PETROLEUM INDUSTRY EFFLUENT DISCHARGES: EXPERIENCE IN ESSO PETROLEUM COMPANY U.K. REFINERIES,
Esso Petroleum Co. Ltd., London (England).
J. S. Lemlin.
Water Science and Technology, Vol 13, No 7, p 437-464, 1981. 17 Fig, 2 Tab, 10 Ref.

Descriptors: *Oil pollution, *Monitoring, *Ecological effects, Water pollution effects, Water pollution sources, Water pollution control, Wastewater treatment, Water quality control, *United Kingdom, Cooling water, Process water, Ballast, Industrial wastewater, Oil refineries, Salt marshes, Wastewater disposal, Fawley Refinery, Milford Haven Refinery, Aquatic life.

Uses of water, potential pollution sources, effluent treatment processes, and ecological monitoring in two United Kingdom Esso petroleum refineries are described. Ecological monitoring programs have been successfully integrated into the management of refinery effluents. Fawley Refinery, capacity 19.2 million tons per year, is a complex installation using large quantities of water. Milford Haven Refinery, capacity 15 million tons per year, is almost exclusively air cooled. After treatment, Fawley effluents are discharged through two outfalls into a salt marsh. Average effluent quality is (in mg per liter): oil, 10.0; phenols, 0.4; sulfides, 0.3, ammonia, 3.0; and BOD, 30.0. The salt marshes had suffered significant oil pollution damage by the late 1960's. Therefore, an ecological monitoring system was set up. The average Milford Haven effluent contains (in mg per liter): oil, 16; phenols, 0.45; sulfides, 0.3; ammonia, 1.0; and BOD, 35. It discharges through a single outfall into a rocky bay. Increasing the residence time of effluent in lagoons and general tightening of procedures decreased the pollution levels in the 1970's. Ecological monitoring has pointed out the most cost-effective strategies for reducing environmental damage for each site. (Cassar-FRC)
W82-01913

THE HAZARDS OF HAZARDOUS WASTE MANAGEMENT,
Maryland Dept. of Natural Resources, Annapolis.
For primary bibliographic entry see Field 6E.
W82-01940

A PROPOSAL FOR RECLAMATION BY DILUTION OF IRRIGATION WATER,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 3C.
W82-01943

UPLAND MARSH FOR WATER QUALITY CONTROL,
Agricultural Research and Education Center, Lake Alfred, FL.
For primary bibliographic entry see Field 5B.
W82-01962

WATER QUALITY IMPACTS EXCHANGING WATER BETWEEN SEA AND A CLOSED ESTUARY,
Ministry of Transport and Public Works, Middelburg (Netherlands). Environmental Research Div.
C. P. de Vos, J. S. L. Vink, B. A. Bannink, and J. Leentvaar.
Water Science and Technology, Vol 13, No 7, p 271-285, 1981. 9 Fig, 5 Ref.

Descriptors: *Water quality management, *Estuaries, *Dams, *Destratification, *Salinity, Water quality control, Sluices, Mixing, Stratification, Lakes, Salt water, Polders, Oxygen balance, Grevelingen, *Netherlands.

The estuarine branch, Grevelingen, in the Netherlands was dammed off from the North Sea in 1971 to create a large salt water lake for nature conservation, recreation, and fisheries development. The salinity level decreased during excess precipitation and polder water discharges. To remedy problems of salinity regulation, a water exchange sluice was completed in the dam by 1978. The new exchange of water between the lake and the North Sea was accompanied by a permanent salt-stratification in the lake. In the summer of 1979, oxygen consumption in the hypolimnion was greater than the replenishment, while in June and July, oxygen levels near the bottom decreased to less than 1 milligram/liter. The exchange of sea and lake water during the summer did not prevent stratification of the lake. Oxygen balance problems were solved after the increased inflow of oxygen-saturated seawater into the hypolimnion due to density differences late in July. The sluice was closed during the 1980 summer period. (Geiger-FRC)
W82-01991

WATER QUALITY INDICES: AN ADDITIONAL MANAGEMENT TOOL,
Middlesex Polytechnic, London (England).
M. House, and J. B. Ellis.
Water Science and Technology, Vol 13, No 7, p 413-423, 1981. 8 Fig, 15 Ref.

Descriptors: *Water quality management, *Classification, Management planning, Planning, *United Kingdom, Rivers, Water pollution, Scottish Development Department, *Water quality indices.

A comparison of the geometric weighted formulation of the Scottish Development Department (SDD) water quality index with the National Water Council (NWC) and Thames Water Authority (TWA) classifications showed 76% and 81% agreement, respectively. This suggests that, with modifications, the SDD could be successfully used to monitor changes in water quality. In its present form it is most accurate in good quality waters and less accurate in low quality waters. There are several advantages to adopting a water quality index: (1) it reduces a large amount of data to a single index, (2) it reduces subjective judgments, (3) it provides more information on water quality, (4) it allows greater detail in describing specific river reaches and in showing small changes in quality, (5) it reports specific quality rather than qualitative approximations, and (6) it is more easily understood by laymen. (Cassar-FRC)
W82-01994

REVIVING THE RIO RECONQUISTA,
Thames Water Advisory Service (England).
P. Borrows.
Water, No 38, p 24-26, May, 1981. 1 Fig.

Descriptors: *Water pollution control, *Planning, Water pollution prevention, Rivers, Industrial wastes, Effluents, Food-processing wastes, *Argentina, *Odors, *Hydrogen sulfide.

The polluted condition of the Rio Reconquista in Argentina gave rise to the generation of hydrogen sulfide to such an extent that in the summer many stretches of the river could not be approached. The Rio Reconquista rises in the grass lands to the west of Buenos Aires. The pollution in the river has been caused by uncontrolled discharges of domestic sewage and industrial wastes, with the latter arising from a variety of sources, either from food processing plants or petrochemical industries. One of the first steps taken to correct the situation involved the establishment of a pollution control

authority with adequate powers to stop the major sources of pollution from entering the river. Work was designed to take place in two stages. First, an initial three months were needed to tender documents and undertake a further study of the pollution. Second, a longer period extending over several years was set to build and commission the sewerage system extension and possibly another treatment works built on the river Matanza. Groundwater and resource planning would also be undertaken. (Baker-FRC)
W82-02014

WASTE DISPOSAL--CHOOSING AND LICENSING SITE,
Severn Trent Water Authority, Birmingham (England).
K. Selby.
Water, No 30, p 11-13, January, 1980. 1 Tab.

Descriptors: *Waste disposal, *Groundwater pollution, *Water pollution prevention, Site selection, Licensing, Legal aspects, Underground waste disposal, Water quality, *Great Britain.

Water authorities in Great Britain are responsible for ensuring the protection and proper use of all inland water, including water in the underground strata. The Control of Pollution Act of 1974 includes a waste disposal site licensing procedure which for the first time provides for proper control of waste disposal operations and for the involvement of water authorities in the licensing of sites. Factors affecting the degree of risk to water quality from waste disposal operations include the chemical and physical nature of the wastes, the quality and volume of leachate produced, the geology and hydrogeology of the disposal site, and the existing and desired quality of the water resource which is at risk. The aquifer protection policy developed by the Severn Trent Water Authority is based on identification of the resource vulnerability in hydrogeological terms and classification of activities considered to present a risk of groundwater pollution in each resource risk area. The four risk areas or protection zones range from high risk areas within one kilometer of public water supply boreholes, within which no waste disposal sites are permitted, to areas not located over either major or minor aquifers, in which there are few restrictions on the establishment of waste disposal sites unless surface water protection is needed. This policy allows for the identification of clearly acceptable or clearly unacceptable proposals, allowing limited resources to be concentrated on the marginal and more important proposals. Conditions which the water authority has recommended be included in some licenses for the protection of water quality have covered the type and volume of waste to be deposited, the inclusion of facilities at the site to prevent the formation and movement of leachate, leachate treatment and disposal facilities and other drainage provisions, and monitoring arrangements. Of recommendations made with respect to 879 licenses, only 6 have resulted in appeals. (Carroll-FRC)
W82-02035

WATER POLLUTION: A RISK TO THE FUTURE IN THE CASE OF THE RHINE (EAUX POLLUEES' AVENIR EN DANGER DANS LE CAS DU RHIN),
Zurich Service des Eaux (Switzerland).
M. Schalekamp.
Aqua, No 6, p 126-136, 1980. 56 Fig.

Descriptors: *Water quality control, *Chemical wastes, Water pollution control, Industrial wastes, Fish, *Rhine River.

Measurements made in 1978 by the International Committee of Rhine Basin Water Supply Undertakings show that water quality in the Rhine River has improved. For example, the level of lignosulfonic acid has fallen considerably. Although fish can now live in the river, they are still inedible because chemical pollution levels and salt content are high. Concentrations of toxic substances are 14.5 times higher in the lower Rhine than in Lake Constance. Prompt implementation of the Salt Convention, a treaty on chemical pollution, and better treatment of industrial wastes will further improve water quality in the Rhine, which serves as the water supply for 20 million people. This report urges that the health of the Rhine should not be judged by the fact that fish are returning, but rather in terms of water quality and human health. (Cassar-FRC)
W82-02067

WATER QUALITY MANAGEMENT OF LAKE NEUSIEDLER, AUSTRIA,
Federal Inst. on Water Resources Research (Switzerland).
For primary bibliographic entry see Field 5C.
W82-02090

POLAND: COMING TO GRIPS WITH POLLUTION,
D. Hinrichsen.
Ambio, Vol 10, No 1, p 40-41, 1981. 1 Tab.

Descriptors: *Industrial wastes, *Water pollution sources, *Water pollution control, Air pollution, Environmental effects, Acid rain, *Poland.

Groundwater pollution by coal mining operations and subsidence of groundwater and river levels are among the problems caused by industrialization in Poland's Silesian Triangle. Steel mills, coal-fired power stations, coal mines, chemical plants, and metallurgical and engineering companies are highly concentrated in this area; many use outdated technologies. Acid rain is a serious problem, affecting soil and vegetation. The Vistula River in this area is polluted beyond all acceptable limits, and its water level has been dropping by 10 cm a year. The Polish Academy of Sciences Research Center for Nature Protection and Natural Resources in Krakow and the Institute of Environmental Engineering, Zabrze, are working to improve the environment. However, they are understaffed and underfinanced and must consider tradeoffs between the country's need for more and cheaper energy and environmental improvement. (Cassar-FRC)
W82-02092

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

LAND-USE CONFLICT IN WILDLAND WATERSHED MANAGEMENT: A MULTIPLE OBJECTIVE ECONOMIC ANALYSIS,
California Univ. Davis.
W. C. Kinney.
PhD Dissertation, 1980. 270 p, 16 Fig, 23 Tab, 107 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-05389.

Descriptors: *Land use, *Watersheds, Model studies, Mathematical models, Economics, Multiobjective planning, Forest management, *Resources management, Multiple use of resources.

Economically efficient wildland watershed management requires a means of determining the relative value of noncommensurable forest outputs. This study develops a multiple objective mathematical programming model for determination and analysis of marginal economic tradeoffs between these outputs. These inputed tradeoffs are used to analyze alternative forest management activities, each of which produce a specific combination of joint forest outputs. Using a study area watershed in the Los Padres National Forest in California, the analysis first attempts to define the watershed's efficient production possibilities for these joint outputs. Successive parameterization of objective constraint levels generates the watershed's efficient production possibilities frontier. The Los Padres Forest has no commercially productive timber lands, and exists primarily for watershed protection. The predominant vegetation is chaparral, a group of bushy species which are highly susceptible to fire at certain times. Alternative management activities analyzed include prescribed rotational burning and vegetative type conversion. The joint production process is defined by the level of water runoff, sediment erosion, wildfire output, wildlife habitat potential, and visual resource impact for a given level of investment in intensive fuel management activities. The programming model identifies a relevant subset of all possible efficient output vectors, and provides the rates of product transformation betwen them. The economic analysis of these watershed management alternatives indicates that present vegetative conditions are generating significant inefficiencies in the management of public resources. (Sinha-OEIS)
W82-01675

WATER MANAGEMENT IN THE COLORADO RIVER BASIN: AN APPLICATION OF NON-LINEAR TRANSPORTATION ALGORITHMS,
Arizona Univ., Tucson. Dept. of Economics.
K. E. Boles.
PhD Dissertation, 1980. 110 p, 7 Fig, 2 Tab, 67 Ref, 2 Append, University Microfilms International Ann Arbor, MI; Order No GAX-17769.

Descriptors: *Model studies, *Water management, *Water resources, *Colorado River basin, Land use, Treatment, Flow augmentation, Recharge, Reclamation, Recycling, Desalination, Transportation algorithms.

Recent developments in transportation algorithms and a decomposition strategy are utilized to develop a comprehensive water resources management model of the Colorado River Basin which can be solved quickly. This model permits both quality and quantity levels to be considered at all points within the system. The quality and quantity requirements are used as parameters in the determination of an optimal system of piping, treatment levels, recycling, reclamation, groundwater recharge, reservoir usage, flow agmentation, land use and other management alternatives. Several optimum systems are then compared as to costs, allocations and quality of output under differing legal, economic, technological and environmental assumptions. A full analysis of the Colorado River Basin water supply and quality situation under various constraint assumptions is presented. A thorough analysis is performed of the interaction and impacts of eight Bureau of Reclamation salinity control projects. The primary emphasis is on examining the impacts and alternatives involved with the Yuma desalination project. Finally a summary of both the Colorado River Basin analysis and the success of using the model and solution technique is given along with conclusions derived from these two facets of the study. (Sinha-OEIS)
W82-01677

A STRUCTURAL SYSTEMS ANALYSIS APPROACH TO DETERMINE OPTIMUM OPERATING POLICIES FOR IRRIGATION AND HYDROPOWER GENERATION FOR WATER RESOURCES, SYSTEMS,
California Univ., Berkeley.
F. J. Gonzales-Villarreal.
Doctor of Engineering Dissertation, 1980. 233 p, 29 Fig, 17 Tab, 58 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-12930.

Descriptors: *Water resources development, *Irrigation, *Computer programs, Mathematical models, *Mexico, Powerplants, Hydropower generation.

The main contribution of this research is the development of a methodology and the implementation of the computer programs for analyzing water resources systems with a twofold purpose; irrigation and power generation. The methodology can be classified as a multilevel hierarchical approach. Special attention is given to integrating the optimization and simulation models that describe the different parts of subsystems of the whole system as well as to analyzing the stochastic nature of the streamflow and other local conditions within the framework of the targets and objectives of a national agricultural production system and a regional power generation set-up. The methodology is

applied to the case of the Yaqui River in northwestern Mexico. (Sinha-OEIS)
W82-01680

A LIMNOLOGICAL INVESTIGATION OF A TROPICAL FRESH-WATER ECOSYSTEM: THE BELIZE RIVER, BELIZE, CENTRAL AMERICA,
Western Michigan Univ., Kalamazoo.
For primary bibliographic entry see Field 5G.
W82-01682

THE MANAGEMENT OF WATER RESOURCES: A SYNTHESIS OF GOAL PROGRAMMING AND INPUT-OUTPUT ANALYSIS WITH APPLICATION TO THE IOWA ECONOMY,
Iowa State Univ., Ames.
E. K. Mensah.
PhD Dissertation, 1980. 243 p, 3 Fig, 36 Tab, 61 Ref, 2 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-06030.

Descriptors: *Water resources development, *Economics, *Iowa, Management, Model studies, *Water management, Resources management, Multiobjective planning.

This study focuses on the development of a multiobjective model combining input-output analysis and goal programming for providing guidance in the allocation of the water resources of Iowa. The model was applied in the allocation of water between the economic sectors of the state of Iowa to satisfy the state's water needs for economic and demographic projections to 2020. The 1972 input-output technical coefficients matrix of Iowa developed by Barnard was modified to include commodity-wise marginal properties to consume. This extension of the basic input-output model was aimed at capturing the income effect of consumption on production and resource utilization. It thus includes a comprehensive multiplier analysis of the effects of a shock in one sector of the economy throughout the entire economic system. The analysis has confirmed that the state of Iowa, as well as its eight major water supply areas, have enough water resources to satisfy the long term growth projections to the year 2020. This conclusion embraces only quantity of water regardless of quality demanded or quality supplied. (Sinha-OEIS)
W82-01685

RANDOM DIFFERENTIAL EQUATIONS IN WATER QUALITY MODELING,
Utah State Univ., Logan.
B. A. Finney.
PhD Dissertation, 1980. 190 p, 43 Fig, 8 Tab, 42 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-05105.

Descriptors: *Model studies, *Mathematical models, *Water quality, Biological Oxygen Demand, Equations, Probabilistic process, Differential equations, Dissolved oxygen.

A probabilistic river water quality model is developed with the capability of determining the joint and marginal probability density function of BOD and DO at any point in a river. The one dimensional steady-state model can be applied to a river system with any reasonable number of point loads and diversions and lateral surface and subsurface inflow. The model can simultaneously consider randomness in the initial conditions, inputs, and coefficients of the water quality equations. Any empirical or known distribution can be used for the initial condition. The randomness in the water quality equation inputs and coefficients is modeled as a Gaussian white noise process. The joint pdf of BOD and DO is determined by numerically solving the Fokker-Plank equation. Moment equations are developed which allow the mean and variance of the marginal distribution of BOD and DO to be calculated independently of the joint pdf. An upper limit on the coefficient noise variance parameter is presented for which the BOD-DO covariance matrix will be asymptotically stable. The probabilistic river water quality model is applied to two problems, a sensitivity problem and a hypothetical problem. (Sinha-OEIS)
W82-01688

THE TECHNOLOGY TRANSFER PROCESS IN WATER RESOURCES R&D MANAGEMENT,
Stanford Univ., CA. Dept. of Civil Engineering.
C. E. Downs.
PhD Dissertation, 1980. 217 p, 24 Fig, 13 Tab, 162 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-11627.

Descriptors: *Water resources, *Model studies, *Water policy, Technology, Planning, Research and development, Saline water.

The scope of this study, for reasons of manageability, is restricted to water resources R&D management considerations, and particularly the adaptiveness of R&D resource allocation decisions. The study is divided into two parts in order to afford an intuitive feel for the adaptive interrelationships between the technology transfer process, the R&D management function, and the public policy making process as well as a theoretical perspective for modeling and analysis. The first part is devoted to the development of the nature and context of the problem, its basis in research and the policy state space concept and model. The policy state space model has its basis in the recognition of the common cybernetic characteristics of the adaptive processes involved and suggests a first step toward a new theory of public policy evaluation. The second part is a case study of the adaptiveness of the R&D policies for the former Office of Saline Water. The objective of the case study is to illustrate the application of the policy state space model and to assess its utility both in evaluating the adaptiveness of the policy making process in water resources R&D management and its symbiotic link with the technology transfer process as well as in broader studies of the policy making process. (Sinha-OEIS)
W82-01694

POLLUTION PERMITS AND MARKETS FOR WATER QUALITY,
Wisconsin Univ.-Madison.
W. B. O'Neill.
PhD Thesis, 1980. 199 p, 17 Tab, 119 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-07851.

Descriptors: *Water pollution control, *Water quality, *Pollution abatement, Economic justification, Market value, Permits, *Model studies, Transferable discharge permits(TDP's).

The analysis begins with the development of an economic river basin model which identifies a well-defined index of water quality as a commodity subject to competing demands by polluters. The model utilizes linear programming optimization techniques to conduct a cost-effectiveness comparison of the market strategy with two commonly proposed alternative abatement plans. Comparison of the abatement costs implied by the three strategies provides information about the effect of market transactions costs on the choice of a control plan. In particular, the cost difference between the market and the alternative plans is an estimate of the maximum level of transactions costs consistent with choice of the market strategy. Initially a single period model is constructed which assumes steady-state conditions on the Fox River in Wisconsin. Simulation of a variety of market structures and river conditions provides evidence that the market strategy may be significantly less costly than the alternative plans. A multi-period model is also developed and used to analyze the choice of control strategy in the case of varying river conditions and the associated assimilative capacities. Fox River simulation results again support the cost-effectiveness of the transferable discharge permits (TDP's) market. In both sets of analyses, the market simulations also provide information on the nature of permit trading and on the type of market supervision which would be necessary if a TDP market were to be instituted. (Sinha-OEIS)
W82-01699

FLOOD CONTROL ON THE PARANA AND PARAGUAY RIVERS,
Motor-Columbus Consulting Engineers, Inc., Baden (Switzerland).
For primary bibliographic entry see Field 2E.
W82-01707

OPTIMIZATION OF WATER RESOURCES FOR IRRIGATION IN EAST JORDAN,
Southampton Univ. (England). Inst. of Irrigation Studies.
J. R. Rydzewski, and H. A-H. Rashid.
Water Resources Bulletin, Vol 17, No 3, p 367-372, June, 1981. 1 Fig, 4 Tab, 9 Ref.

Descriptors: *Irrigation, *Water allocation, *Water deficit, *Jordan, Diversion, Conjunctive use, Water resources, Agriculture, Water management, Model studies, Optimization.

Optimal allocation of water resources to three agricultural areas in the arid region east of the Jordan River was accomplished, using nonlinear programming to maximize productivity of irrigation water while allowing for crop water deficits, and linear programming to determine the cheapest alternative. The three agricultural regions are I, 14,000 ha; II, 9,000 ha; and III, 13,000 ha of Cultivable Commanded Area. The Jordan River itself becomes too saline for irrigation purposes 50 km south of its source in Lake Tiberias. The available water sources are its eastern tributaries, the Yarmouk, Zarqa, and Arab rivers and their storage reservoirs, major groundwater resources in Region III, and promising groundwater sources in Region II. The cropping pattern suggested for this frost-free region is 20% perennial (citrus, banana, and lucerne), 80% winter crops (wheat, barley, vegetables, onions, and berseem), and 50% summer crops (vegetables, sunflower, groundnut, sesame, and fodder). Yearly crop water requirements are 19,400 cu meters per ha with no rainfall and 15,800 cu meters per ha allowing for some rainfall. Annual crop demand would be at least 760 million cu meters with 70-75% efficiency. A table lists the recommended monthly water allocation for 3 years for each agricultural region from each of eight water sources, the Yarmouk River and its storage being prominent. (Cassar-FRC)
W82-01742

HYDROGEOLOGY OF WELL-FIELD AREAS NEAR TAMPA, FLORIDA, PHASE 1--DEVELOPMENT AND DOCUMENTATION OF A TWO-DIMENSIONAL FINITE-DIFFERENCE MODEL FOR SIMULATION OF STEADY-STATE GROUND-WATER FLOW,
Geological Survey, Tallahassee, FL. Water Resources Div.
C. B. Hutchinson, D. M. Johnson, and J. M. Gerhart.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $17.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-630, 1981. 129 p, 11 Fig, 2 Tab, 12 Ref.

Descriptors: *Geohydrology, *Model studies, *Simulation analysis, *Groundwater movement, Finite element method, Aquifer characteristics, Wells, Water table, Leakage, Pumping, Drawdown, *Florida, Tampa, Floridan aquifer, Cross Bar Ranch well field, Morris Bridge well field.

A two-dimensional finite-difference model was developed for simulation of steady-state groundwater flow in the Floridan aquifer throughout a 932-square-mile area, which contains nine municipal well fields. The overlying surficial aquifer contains a constant-head water table and is coupled to the Floridan aquifer by a leakage term that represents flow through a confining layer separating the two aquifers. Under the steady-state condition, all storage terms are set to zero. Utilization of the head-controlled flux condition allows head and flow to vary at the model-grid boundaries. Procedures are described to calibrate the model, test its sensitivity to input-parameter errors, and verify its accuracy for predictive purposes. Also included are attachments that describe setting up and running the model. An example model-interrogation

run shows anticipated drawdowns that should result from pumping at the newly constructed Cross Bar Ranch and Morris Bridge well fields. (USGS)
W82-01780

THE LAKE TAHOE BASIN: A SYSTEMS ANALYSIS OF ITS CHARACTERISTICS AND HUMAN CARRYING CAPACITY,
Energy Policy Studies, Inc., Omaha.
M. W. Gilliland, and B. D. Clark.
Environmental Management, Vol 5, No 5, p 397-407, September, 1981. 5 Fig, 1 Tab, 14 Ref.

Descriptors: *Lake Tahoe, *Carrying capacity, *Systems analysis, Public policy, Planning, Watershed management, Watershed protection, Legal aspects, Urbanization, Environmental effects, Ecological effects.

An environmental assessment of the Lake Tahoe Basin was made which was aimed at analyzing the federal role in the preservation of the area. A systems approach was utilized which is applicable to both urban and natural environments that are characterized by similar resource constraints. Urban growth in the area has been exponential and has caused significant damage to the environment. The area experiences congestion, violations of air and water quality standards, losses in wildlife, and degradation of visual resources (views). Full protection for the area requires the definition of a carrying capacity for the basin and management of the growth process. An environmental thresholds standards analysis was performed, using three threshold levels of sediment and nutrient inputs into the lake. The three hypothetical loading rates correspond to three levels of lake water quality, and thus to three possible perceptions of ecological damage. Available mitigation funds also influence the calculated carrying capacity of the basin. (Small-FRC)
W82-01807

LONG-RUN EFFECTS OF ENVIRONMENTAL REGULATION,
International Bank for Reconstruction and Development, Washington, DC. Policy Planning Div.
R. G. Ridker, and W. D. Watson.
Natural Resources Journal, Vol 21, No 3, p 565-587, July, 1981. 3 Fig, 7 Tab.

Descriptors: *Long-term planning, *Water pollution control, *Regulations, *Economic aspects, Environmental effects, Planning, Water policy, Population growth, Effluent standards, Social costs, Cost-benefit analysis.

The relationship between the generation of pollutants, environmental regulations, and economic growth over a 50-year period is examined. It appears that pollution can be substantially improved without undue interference with the national economy as long as fiscal and monetary policy brings about increases in savings and as long as disadvantaged sectors are helped. On the negative side, there is profound ignorance on the environmental consequences of past and future human activities or the results of using different forms of energy. Five quality factors should be considered in judging the conclusion: Policies analyzed were based on uniform national emissions standards, which do not account for overcontrol or undercontrol in some areas. Pollutants were considered as an aggregate. Investments for pollution abatement and for energy-efficient capital may reduce economic growth if there are not sufficient savings to finance the extra capital requirements. Constraints of local requirements and decisions could seriously reduce growth. Uncertainty about future environmental pressures may also slow economic growth; for example, at some point acid rain, loss of topsoil, or rapid population growth may produce acute pressure. A table shows the indexes of per capita economic welfare for relaxed controls, strict controls, least-cost controls, and controls at 1975 levels for the years 1975, 1985, 2000, and 2025. The least-cost policy would lead to the highest per capita welfare index (3.22) by the end of the 50-year period vs. 3.20 for relaxed controls, 3.17 for strict controls, and 3.14 for 1975 controls. (Cassar-FRC)
W82-01848

SIMULATING EFFECTS OF COMBINED SEWER OVERFLOWS,
Lozier Engineers, Inc., Rochester, NY.
H. M. Shapiro, J. B. Blenk, and M. P. Allen.
Water/Engineering and Management, Vol 128, No 9, p 79-80, 82, 84, September, 1981. 3 Fig.

Descriptors: *Wastewater treatment, *Storm-overflow sewers, *Wastewater pollution, *Model studies, *Project planning, Simulation analysis, Mathematical studies, Sewers, Storm sewers, Storm runoff, Hydraulic models, Cost analysis, *Chemung County, New York.

Chemung County, New York, has taken measures to upgrade its waste water treatment facilities. A simulation study was organized to determine the cost effectiveness of overflow storage with subsequent treatment, the effect of combined dry weather and treated or untreated overflow on stream standards, and the effects of increased plant efficiency on the reduction of combined sewer overflow (CSO). A STORM-WQRRS (Water Quality River-Reservoir) continuous simulation model was selected to predict the quantity and quality of storm water and dry weather flow. The three major steps involved in these predictions entailed computations of runoff quantity and quality and storage, treatment and overflow of runoff. The WQRRS modeling concept is based on fundamental laws of conservation and kinetics as they apply to studies of continually-stirred-tank reactors and is structured of three separate but interchangeable modules: a reservoir module, a stream hydraulic module, and a stream quality module. The CSO impact on the Chemung River was determined by application of the STORM model to data obtained from a site 5 miles above the CSO source. The WQRRS model yielded results of little value in the evaluation of CSO impact. The WQSTAT statistical program was employed to reduce the output of CSO impact. The WQSTAT statistical program was employed to reduce the output to more usable form. After the simulation analysis was complete, the consultant recommended no additional CSO abatement work at the present time. However, design of a regional treatment facility is currently underway. (Geiger-FRC)
W82-01864

A MULTILEVEL MODEL AND ALGORITHM FOR SOME MULTIOBJECTIVE PROBLEMS,
Chiyoda Chemical Engineering and Construction Co. Ltd., Yokohama (Japan).
N. Takama, and D. P. Loucks.
Water Resources Bulletin, Vol 17, No 3, p 448-453, June, 1981. 1 Fig, 2 Tab, 13 Ref.

Descriptors: *Decision making, *Chemical wastewater, *Multiobjective planning, *Wastewater treatment, Industrial wastewater, Optimization, Planning, Algorithms.

An interactive decision making model is presented to aid in solving multiobjective problems associated with large scale convex multilevel systems. At each step the decision maker carries out pairwise comparisons, which are reflected on higher level decision variables. The procedure is applied to the design of a wastewater treatment system for a chemical manufacturing plant. The performance of the system is evaluated by three criteria: efficiency of the waste treatment process, system reliability, and cost. The treatment system is decomposed into two subsystems, each with a treatment efficiency and a cost criterion. The first subsystem consists of a number of treatment units which are evaluated to obtain the minimum pollutant discharge for a given cost. The second subsystem consists of control units to produce maximum system reliability at a given cost. (Cassar-FRC)
W82-01884

THE ECONOMICS OF COOPERATION OVER COLLECTIVE BADS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
J. B. Braden, and D. W. Bromley.
Journal of Environmental Economics and Management, Vol 8, No 2, p 134-150, June, 1981. 5 Fig, 29 Ref.

Descriptors: *International agreements, *Pollution taxes, Economic aspects, *Theoretical analysis, Water quality control, Water pollution control, Taxes, Model studies, Nonstructural alternatives.

Pollution released in one country frequently produces damages in other nations; for example, both Canada and the U.S. are affected by contaminants in the Great Lakes. This paper adapts concepts of trade in public goods to present a theory of cooperation over reciprocated collective bads. Similar techniques are used for analysis of public goods and exchanged collective bads. Both theories conclude that joint actions involving efforts greater than the sum of those undertaken independently can produce Pareto-superior results, some of which are optimal. The two theories differ in the meaning attached to the trade region and in incentives to cooperate. Since collective bads are damaging to a nation's welfare, cooperation is much more urgent than working out economics in supplying public goods. Although tax policies are useful in studying cooperative arrangements, they present many obstacles in practice. Among the obstacles involved in making agreements between reciprocating polluters are costs of negotiations and enforcement, deception, self-interest, and blackmail. Overcoming these problems may involve acquiring accurate information on the physical system and on consumer preferences, agreement on principles of cooperation, and correction of misinformation. (Cassar-FRC)
W82-01909

LOGISTICS OF FARM WATER SUPPLY.
New Zealand Journal of Agriculture, Vol 140, No 6, p 38-39, 41, 43, July, 1980. 6 Fig.

Descriptors: *Water conveyance, *Farming, Water supply development, Water resources development, Rivers, Wells, Pumps, Pipes, Costs, Financial considerations, *New Zealand.

Factors involved in establishing a good water supply system for a farm are reviewed in the form of a case study. The farm site was Massey University's Riverside farm, located five miles south of Mount Bruce in Wairarapa, New Zealand. Originally the farm depended on two small pumps drawing water from the river, which proved to be inadequate for stock watering, farm work and domestic purposes as well as being subject to breakdowns due to flooding in the river. Sound initial planning is needed to build a system. This planning should include an aerial photograph of the farm and a topographical map of the area, an estimate of water requirements for present and future needs, full details and level and flow rate of all available water sources, and the location and level of all outlets, troughs, houses, etc. In this case, with head available on the hills, a pumped gravity system was a natural choice. The system chosen involved drawing water from the river and pumping it into a ring main, the two sides of which join towards the top of the farm to feed a 22,000 liter concrete tank acting as a reservoir. Pipe choices depend on the pressures expected. Pressure is a function of the topography. (Baker-FRC)
W82-02037

6B. Evaluation Process

PUBLIC OPINION AND INTEREST GROUP POSITIONS ON CHESAPEAKE BAY ISSUES: IMPLICATIONS FOR RESOURCE MANAGEMENT,
Maryland Technical Advisory Service, College Park.
P. S. Florestano, and P. A. Rathbun.
Coastal Zone Management Journal, Vol 9, No 1, p 19-39, 1981. 2 Fig, 1 Tab, 11 Ref.

Descriptors: *Resources management, *Public policy, *Policy making, *Chesapeake Bay, Water

management, Water policy, Administrative decisions, Surveys, Recreation, Commercial fishing, Environmental policy, Environmental protection, Nuclear powerplants, Water pollution.

A twofold methodological approach was employed to review public opinion on a number of environmental topics concerning the use and management of the Chesapeake Bay and determine if policies advocated by various public interest groups reflect the preferences of Maryland citizens. Data collected addressed water pollution, government regulation of private land, waterfront construction, and recreational boating, nuclear powerplants, oil spills, responsibility for discharge of toxic substances, dredging of bay channels and port expansions, and preferential treatment for the seafood industry. Telephone surveys of a random sample of state residents, mail surveys of interest groups, and personal interviews with interest-group leaders were conducted to identify policy stands on Chesapeake Bay issues. The findings revealed that interest group policies, in general, reflect the public's attitude on environmental and Bay-related issues. Citizens and interest groups alike did not seem to place more importance on the increased need for energy than for the protection of the environment. (Geiger-FRC)
W82-01642

RIVER THERMAL STANDARDS COSTS IN THE UPPER MIDWEST,
Iowa Univ., Iowa City. Dept. of Civil Engineering.
T. E. Croley, A. R. Gianquinta, and R. A. Woodhouse.
Journal of the Energy Division, Proceedings of the American Society of Civil Engineers, Vol 107, No EY1, p 65-77, May, 1981. 2 Fig, 4 Tab, 15 Ref. OWRT-B-061-IA(2).

Descriptors: *Electric powerplants, *Cost-benefit analysis, *Thermal pollution, *Temperature effects, Powerplants, Thermal powerplants, Environmental effects, Water resources development, Thermal stress, Standards, Water quality standards, Costs, Rivers, Mathematical studies.

An evaluation was made of the marginal (incremental) changes in cooling-related water consumption (evaporative loss) and power-plant cooling costs which result from unit changes in river temperature standards along the Upper Mississippi and Missouri Rivers in the MAPP region. Some hypothetical river thermal standards for powerplants were examined including the extreme cases of free thermal discharge and no thermal discharge. Various restrictive levels for standards are studied for their probable impact on the MAPP region. One way of representing thermal standards is by trade-off relationships which are based on cost/benefits analyses. Environmental objective functions were difficult to define due to the noncommensurable nature of the benefits of fish and wildlife preservation and the costs of meeting certain thermal standards. Decision makers may have difficulty in determining future thermal standards when the costs of providing different levels of environmental protection are considered in the cost/benefit evaluation. (Geiger-FRC)
W82-01655

THE NATIONAL COMMISSION ON WATER QUALITY: A CASE STUDY IN CONGRESSIONAL POLICY ANALYSIS,
Texas Univ. at Dallas, Richardson.
R. B. Outen.
PhD Dissertation, 1980. 335 p, 118 Ref, 4 Append. University Microfilms International, Ann Arbor, MI; Order No GAX81-13925.

Descriptors: *Water quality, *Water policy, Legislation, Behavior, United States, *Case studies, *Congressional policy, National Commission on Water Quality.

This analysis of the National Commission on Water Quality has been structured around a series of propositions concerning the behavior of the National Commission on Water Quality and the Congress. The analysis has demonstrated that the stated propositions concerning 'normative behavior' were not borne out. To a very large degree, they failed to predict the behavior of the National Commission on Water Quality or the Congress in responding to the Commission's reports and recommendations. The data suggest, therefore, that the original goal model was invalid. The Congress-dominated, mixed membership structure of the Commission institutionalized powerful political tensions which subsequently exerted a strong influence on the way the Commission behaved. Through individual personalities and political events peculiar to the issue area provided a unique texture and color, the underlying fabric of behavior was the result of the dominant presence of Congressional members on the Commission. (Sinha-OEIS)
W82-01669

WATER MANAGEMENT IN THE COLORADO RIVER BASIN: AN APPLICATION OF NON-LINEAR TRANSPORTATION ALGORITHMS,
Arizona Univ., Tucson. Dept. of Economics.
For primary bibliographic entry see Field 6A.
W82-01677

THE MANAGEMENT OF WATER RESOURCES: A SYNTHESIS OF GOAL PROGRAMMING AND INPUT-OUTPUT ANALYSIS WITH APPLICATION TO THE IOWA ECONOMY,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 6A.
W82-01685

AN ECONOMIC AND INSTITUTIONAL ASSESSMENT OF THE WATER PROBLEM FACING THE TUCSON BASIN,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
A. H. Griffin.
PhD Dissertation, 1980. 407 p, 14 Fig, 52 Tab, 127 Ref, 3 Append. University Microfilms International, Ann Arbor, MI; Order No GAX80-28529.

Descriptors: *Water supply, *Groundwater, *Water users, *Economics, Arizona, Water rights, Water levels, Mining, Agriculture, Urbanization, Multiple use of resources, *Tucson.

The occurrence and use of water in the region is examined in order to determine the real nature of Tucson's water problem. The institutions governing the use of water in the Basin are described and the disputes between the local water users are discussed. An account is given of the use of water by businesses and residences in Tucson, by the copper mines to the south of Tucson, and by the farms in the Basin. The effect of changes in the cost and availability of water on each of these classes of water user is investigated and the effect that changes in water use could have on the region's economy is discussed. The occurrence of groundwater is described and the merits of the proposed Central Arizona Project are investigated. Various ways of balancing the region's water budget are described and an assessment is made of the effect that curtailing the use of water in the region would have upon the local water users and the region's economy. The principal conclusions are as follows: There is no danger of the supply of water in the Basin becoming exhausted in the near future. The economic and physical effects of the continuing fall in the level of the water table are unlikely to be serious. The region's water budget could be balanced very economically by retiring all agriculture in the region and making modest reduction in the amount of water consumed by urban water users and the copper mines. Given suitable institutional arrangements, curtailing the use of water in the Basin would be a much more economical way of balancing the region's water budget than building the Central Arizona Project. The final conclusion is that the real water problem is an institutional problem. (Sinha-OEIS)
W82-01698

INTEGRATED AGRICULTURAL DEVELOPMENT IN THE PHILIPPINES,
Asian Development Bank, Manila (Philippines). Agriculture and Rural Development Dept.
K. Takase.
International Water Power and Dam Construction, Vol 33, No 8, p 22-24, August, 1981. 2 Fig.

Descriptors: *Irrigation programs, *Resources development, *Philippines, Irrigation, Rural areas, Rural sociology, Cost analysis, Financing, Agricultural engineering.

The Asian Development Bank has approved 81 loans amounting to $1261 million in the area of irrigation and rural development projects. In 1966 the government of the Philippines placed highest priority on rice self-sufficiency centered on irrigation development, which was the prerequisite for growth of the new high yielding varieties of rice. The World Bank proposed the construction of a storage dam on the basis that water resources should first be secured. The Pantabangan dam in Nueva Ecija was completed in August 1974 with the aim of irrigating 83,000 ha. In 1968 the National Irrigation Administration selected a 140 ha pilot area within the Angat River Irrigation System to tackle the problem of ditches and drainage. The design and construction of farm ditches for irrigation and drainage was undertaken, and a number of measuring stations were established in the area. A series of demonstrations and educational campaigns was also conducted. A year after the project began, the density of farm ditches had increased from 16 to 62 m/ha, systematic water application became effective, high yielding varieties were planted, and fertilizers were applied, causing a jump in the pilot scheme paddy yields from 2.3 t/ha in 1968 to 3.1 t/ha in 1969. This project pioneered not only the improvement and rehabilitation of irrigation, drainage and service roads, but also the inegration of land reform, compact farm associations, supervised credit, and the training of staff and leading farmers. Additional attention is needed on cost effectiveness and socio-economic benefits as well as project implementation and loan administration. (Baker-FRC)
W82-01725

ADDENDUM TO: SOURCES OF POWER-PLANT COOLING WATER IN THE DESERT AREA OF SOUTHERN CALIFORNIA--RECONNAISSANCE STUDY,
Geological Survey, Menlo Park, CA. Water Resources Div.
J. H. Koehler, and M. J. Mallory.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $4.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-527, June, 1981. 28 p, 9 Fig, 5 Tab, 14 Ref.

Descriptors: *Evaluation, *Groundwater availability, *Groundwater basins, *Water cooling, *Powerplants, Aquifers, Pumping, Deserts, Water quality, *California, Southern California.

A hydrologic reconnaissance study was made in five basins in southern California previously classified as suitable for providing sufficient ground water for cooling a 1,000-megawatt electric-power generating plant. The criteria used to evaluate the basins were (1) theoretical aquifer response to pumping, (2) alternative sources of water, and (3) chemical quality of water. The basins were ranked relative to each other for the three criteria and in overall suitability. On the basis of subjective analysis, the basins were ranked in the following order for overall suitability: (1) Calzona-Vidal Valley, (2) Middle Amargosa Valley, (3) Chuckwalla Valley, (4) Soda Lake Valley, and (5) Caves Canyon Valley. (USGS)
W82-01773

STATIONARY SOURCE POLLUTION POLICY AND CHOICES FOR REFORM,
Resources for the Future, Washington, DC.
For primary bibliographic entry see Field 6E.
W82-01847

LONG-RUN EFFECTS OF ENVIRONMENTAL REGULATION,

International Bank for Reconstruction and Development, Washington, DC. Policy Planning Div.
For primary bibliographic entry see Field 6A.
W82-01848

SIMULATING EFFECTS OF COMBINED SEWER OVERFLOWS,
Lozier Engineers, Inc., Rochester, NY.
For primary bibliographic entry see Field 6A.
W82-01864

GULF OF MEXICO: A SOCIOECONOMIC VIEW OF COMPETING RESOURCES,
C. O. French.
In: Proceedings of a Symposium on Environmental Research Needs in the Gulf of Mexico (GOMEX), Key Biscayne, Florida, 30 September - 5 October 1979, Volume IIA, May, 1981. p 1-40, 2 Fig, 16 Tab, 59 Ref. National Oceanic and Atmospheric Administration, Miami, Florida.

Descriptors: *Social aspects, *Economic aspects, *Water pollution, *Environmental effects, Competing use, Industrial wastes, Water use, Wetlands, Habitats, Waste disposal, Oil industry, Fisheries, Agriculture, *Coastal waters, *Gulf of Mexico States, Water demand.

The socioeconomic environment of the coastal region of the Gulf of Mexico is highly varied in terms of human quality. Although specific data are essentially unavailable, sound policy development and effective management are dependent upon correct assessment of these factors. The socioeconomic activities that effect the greatest alteration in the Gulf of Mexico region include: demographic changes; industrial development (petroleum, waterborne transportation, and ocean dumping); and commercial fishing. The five states covered by the study are Texas, Louisiana, Mississippi, Alabama, and Florida. The primary ways in which socioeconomic sectors interact with coastal processes are: generation of industrial and domestic wastes that are discharged into the environment; habitat modification such as impounding, draining, polluting, and filling wetlands; and natural resource exploitation, including water use. Various socioeconomic sectors may generate the same kinds of activities, so the environmental impact of one sector is often difficult to distinguish. In general, there has been rapid population growth in the South during the last decade, with the greatest rates of increase occurring in the coastal belt. Increasing industrial development and employment have paralleled urban growth and rural decline. Commercial and industrial resource uses in the Gulf are most closely associated with petroleum and petrochemical production, commercial fishing, recreation, and agriculture. (Moore-SRC)
W82-01901

A COMPREHENSIVE METHODOLOGY FOR PROJECT APPRAISAL AND ENVIRONMENTAL PROTECTION IN MULTINATIONAL RIVER BASIN DEVELOPMENT,
Polytechnic Inst. of New York, Brooklyn. Dept. of Civil and Environmental Engineering.
C. Yapijakis, and A. H. Molof.
Water Science and Technology, Vol 13, No 7, p 425-436, 1981. 5 Fig, 19 Ref.

Descriptors: *River basin development, *Decision making, *Alternative planning, Project planning, Planning, *Cost-benefit analysis, Environmental effects, Social aspects, Political aspects, Water resources development, *International waters.

A decision making method for evaluating alternatives for multinational river basin development is presented. This method intended as a tool, not as a panacea. Factors considered are benefit-cost ratio, capital outlay, environmental and social impacts, and manageability/technology level. Each government creates a coordinating group, a weighting panel, and a rating panel, each composed of specialists and experts. The coordinating group lists project alternatives, defines the factors in terms of its government's policies, and chooses the rating and weighting panels. The weighting panel establishes a weighting scheme for each of the aspects. Each member of the rating panel judges the alternatives in their field of expertise by any method--model construction, experiments, point assignment procedures, etc. Final selection of an alternative is done by one of 2 methods: ranking the alternatives from all countries in a single matrix on an equal weight basis, or producing a single list from the combined project ratings from each country. (Cassar-FRC)
W82-01914

OPTIMAL DESIGN OF BORDER IRRIGATION SYSTEMS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 3F.
W82-01977

TECHNICAL AND ECONOMIC IMPLICATIONS OF INSTALLING AN INDUSTRIAL WASTE-WATER PRETREATMENT PLANT,
Environmental Control Consultancy Services Ltd., London (England).
For primary bibliographic entry see Field 5D.
W82-02044

SEVERN BARRAGE SCHEME GETS FAVOURABLE RESPONSE.
International Water Power and Dam Construction, Vol 33, No 9, p 48-50, September, 1981. 4 Fig.

Descriptors: *Tidal powerplants, *Severn River, *Electric power production, Tidal energy, Tides, Costs, Feasibility studies, United Kingdom, Water use, Cost-benefit analysis.

The configuration for the Severn tidal scheme with the highest cost-benefit ratio is a single basin, with electricity being generated in the ebb mode only. It would have an installed capacity of 7.2 MW and a 19 km-long barrage. It would produce about 13 TWh/year or about 6% of the United Kingdom's electricity demand, and would cost $10,640 million to build. The major benefit of the tidal scheme would be to reduce the amount of coal burnt by 5 to 8 times 10 to the 6th power tons. In the preferred scheme, the optimized number of turbines would be 160, each rated at 25 MW and 9 m in diameter. The economic justification for a barrage is dependent upon the cost of coal and the availability and cost of nuclear power. At the least, tidal power should be viewed as a valuable supplementary source of electricity, and is the leading renewable source. The environmental consequences of a barrage would be wide ranging. (Small-FRC)
W82-02089

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

STANDARDS AND CHARGES IN THE CONTROL OF TRADE EFFLUENT DISCHARGES TO PUBLIC SEWERS IN ENGLAND AND WALES,
York University, Heslington (England). Institute of Social and Economic Research.
M. G. Webb, and R. Woodfield.
Journal of Environmental Economics and Management, Vol 8, No 3, p 272-286, September, 1981. 6 Fig, 5 Tab, 6 Ref.

Descriptors: *Effluents, *Economic aspects, *Industrial wastes, Discharge measurement, Standards, Regulations, Pricing, *Effluent charges, *England, Wales.

The revised charging scheme for discharges of trade effluent to public sewers introduced by the new water authorities in England and Wales are described. The charge scheme has been applied to effluent discharges from industries. The impact of these charges on the dischargers, the instruments used for the control of trade effluents to public sewers, and the relationship between optimal levels of trade effluent charges and levels of capacity at collective sewage works are considered. The revised charging schemes were based on a charging formula as recommended by the National Water Council. The primary aim of the charges is to allocate to the dischargers the costs incurred by the water industry for the reception, conveyance, treatment and disposal of waste products produced by industry. However, there is a total lack of empirical evidence to justify the chosen formula. Other problems involved in the use of the trade effluent charging scheme in combination with the consent standards include the determination of optimal collective treatment capacity, the optimal allocation of consent standards for given capacity, and the determination sample of discharges in the Southern Division of the Yorkshire Water Authority. One of the greatest problems was the use of regionally equalized charges based on historic accounting costs, which give dischargers inaccurate price signals. The study demonstrated that although the charging formula is related to volume, biological and sludge strengths of effluent treated, in practice the major determinant of a discharger's charge is the volume of effluent discharged. (Baker-FRC)
W82-01717

CHARGING FOR WATER SUPPLY IN ENGLAND AND WALES IN THE 1980S,
National Water Council, London (England).
D. Kinnersley.
Aqua, No 3, p 7-9, 1981.

Descriptors: *Water metering, *Water rates, Water policy, Water distribution, *England, *Wales.

Water meters are scheduled for installation in England and Wales beginning April 1981. At present only 5% of consumers, mainly industrial and agricultural, are metered. This system replaces the property tax type of charge in force since Victorian times. Not many shops and businesses have responded to the opportunity for metering, since water is one of their minor concerns. It is expected that only 20% of households will be metered by 1990, because installation and maintenance costs are the responsibility of the consumer. (Cassar-FRC)
W82-01722

CHARGING POLICIES FOR WATER SERVICES,
Leicester Univ. (England). Dept. of Economics.
P. R. Herrington, and M. G. Webb.
Water Services, Vol 85, No 1025, p 341-344, 346-347, July, 1981. 13 Ref.

Descriptors: *Water policy, *User charges, *Marginal costs, Public policy, Costs, Economic aspects, Legal aspects, *United Kingdom.

The objectives for nationalized industries set out in White Papers are applied to the water industry in this consideration of charging policies. The Water Act of 1973 set April 1981 as the date by which water authorities in England and Wales were to levy chages that are non-discriminatory and related to supply costs. Charging policies based on marginal costs are suggested to generate revenues which exceed costs and depreciation. Some of the difficulties with such a project include the problem of measurement of marginal costs, the metering of consumers not now metered, and the satisfaction of externally imposed financial objectives. The present charges are based on the rateable value of consumer's premises and are generally unrelated to the costs which consumers impose on water authorities. Thus, a transition period would be required before the policy based on marginal costs was fully implemented. Customers who would be adversely affected by the policy change would have time to adjust during this transition. (Small-FRC)
W82-01734

THE CALIFORNIA STATE WATER PROJECT--CURRENT ACTIVITIES AND FUTURE MANAGEMENT PLANS.
California State Dept. of Water Resources, Sacramento.
For primary bibliographic entry see Field 6E.
W82-01851

REGULATION FOR ENVIRONMENTAL PROTECTION: THE NANTICOKE INDUSTRIAL COMPLEX, ONTARIO, CANADA,
Waterloo Univ. (Ontario). Dept. of Geography.
For primary bibliographic entry see Field 6E.
W82-02024

WATER: A LOW-PRICED BUT HIGH-COST RESOURCE,
Murdoch Univ. (Western Australia).
C. D. Ditwiler.
Search, Vol 12, No 3/4, p 73-77, 1981. 10 Ref.

Descriptors: *Water policy, *Social aspects, *Pricing, Water allocation, Water conservation, Water resources development, Water resources management, Water law, Planning, Economic aspects, Population dynamics, *Australia, Urban sociology.

In Australia, a dry continent, the government controls the development and allocation of water supplies. The price of water is low relative to its cost. Water conservation, recirculation, and transfer schemes receive little attention. Factors influencing water development strategies are population and economic growth and the trend toward the urban-oriented quality of life. Public concern over water will likely emerge in an indirect way. Problem areas may include the social impacts (financial and nonfinancial) of water supply and sewer system construction and pricing on urban development, the social costs of a uniform price for water of all qualities and at all periods of use (pea and off peak), and the social costs of ignoring declining groundwater tables. The water supply must be managed in an integrated manner on a regional basis in connection with other physical resources such as land and air. (Cassar-FRC)
W82-02061

6D. Water Demand

WATER REQUIREMENTS AND MAN-INDUCED CLIMATE CHANGE,
Utah State Univ., Logan. Dept. of Agriculture and Irrigation Engineering.
For primary bibliographic entry see Field 2D.
W82-01633

A STRUCTURAL SYSTEMS ANALYSIS APPROACH TO DETERMINE OPTIMUM OPERATING POLICIES FOR IRRIGATION AND HYDROPOWER GENERATION FOR WATER RESOURCES, SYSTEMS,
California Univ., Berkeley.
For primary bibliographic entry see Field 6A.
W82-01680

AN ECONOMIC AND INSTITUTIONAL ASSESSMENT OF THE WATER PROBLEM FACING THE TUCSON BASIN,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
For primary bibliographic entry see Field 6B.
W82-01698

MOROCCO'S LARGEST MULTIPURPOSE SCHEME,
Ministere des Travaux Publics et des Communications, Rabat (Morocco). Direction de l'Hydraulique.
For primary bibliographic entry see Field 8A.
W82-01724

SUSTAINING THE GROWTH OF PROVENCE.
International Water Power and Dam Construction, Vol 33, No 8, p 28-29, August, 1981.

Descriptors: *Irrigation programs, *Water supply development, Provence, *France, Drought, Water demand, Water shortage, Water supply, *Water resources development, Civil engineering.

The Provence Canal Company's attempts to meet the various water demands of the Mediterranean region of France are described. The problem of water is especially crucial in areas bordering on the Mediterranean Sea. The Provence area has always suffered a lack of water, due to geographical and climatic conditions. Tourists were met with a water shortage in the hotels in the area, brought about by a severe drought. Fortunately water is close at hand, coming from the Alps or from the peaks in the Basses-Alps region. The conduit is the Verdon river, which joins with the Durance river in the plains at the bottom of the Rhone valley. Since the Verdon runs from east to west, its water must be artificially channelled toward the coastal region. Shortly after the Second World War, the regional development policy in France took concrete form in a series of five-year plans to provide modern facilities in poorer areas of France. The Provence Canal was built; its first major aim was to halt the economic decline of the rural areas of France, caused by water shortages. The Provence Canal Company won the concession to build a canal in 1963 as part of the overall plan to develop the basin of the Durance river. Swift growth of industry around Marseilles in the past decade has emphasized the need for adequate water supplies. The needs of agriculture are equally extensive, and farming happens to be one of the most essential functions of the region from an economic, social and ecological point of view. Between 1969 and 1976 additional canals were constructed to link Rians to coastal regions situated to the east and west of Toulon. The third section, scheduled for completion in 1985, will consist chiefly of two branches, the Marseilles-East branch and the Var branch leading to the Arcs, and the irrigation of 27,000 additional ha of farmland. (Baker-FRC)
W82-01738

OPTIMIZATION OF WATER RESOURCES FOR IRRIGATION IN EAST JORDAN,
Southampton Univ. (England). Inst. of Irrigation Studies.
For primary bibliographic entry see Field 6A.
W82-01742

IRRIGATION FOR BRAZIL'S POLIGONO DAS SECAS,
Themag Engenharia Ltda., Sao Paolo (Brazil).
For primary bibliographic entry see Field 3F.
W82-01744

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: ALLEGHENY RIVER BASIN; PENNSYLVANIA-NEW YORK.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Available from the National Technical Information Service, Springfield, VA 22161 as DE82-00444, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0083, Revised March, 1981. 16 p, 3 Fig, 7 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Allegheny River basin, Navigation, Reservoirs, Water use, Wild rivers, Flood control, Water pollution control, Planning, Pennsylvania, New York.

This revised report presents updated information on the water resources of the Allegheny River Basin, and information on new and planned developments. There are two existing Federal navigation projects on the river, one for open channel improvement and the other for slack-water improvement. There are 19 reservoirs with storage capacities of over 5,000 acre-feet. Two of these reservoirs are used for hydroelectric power production, and there are nine steam-electric generating plants drawing a total of 792 mgd of water from the Allegheny and its tributaries. There are six outstanding preliminary permits and 13 preliminary permit applications pending for nine hydroelectric projects. Sections of the Allegheny and Clarion Rivers have been disqualified for inclusion in the National Wild and Scenic Rivers System, but an additional section of the Allegheny is being considered. There are about 30 potential hydroelectric project sites in the Allegheny River Basin. Additional needs in the basin addressed by recent studies include flood control, pollution control, water supply and wastewater management. (Brambley-SRC)
W82-01751

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; COLORADO RIVER BASIN, TEXAS.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0079, Revised February, 1981. 17 p, 3 Fig, 6 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Colorado River basin, Texas, Reservoirs, Water storage, Cooling water, Water supply, Flood control, Irrigation, Water quality.

This revised report presents updated information on the water resources of the Colorado River Basin, Texas, and information on new and planned developments. There are 32 reservoirs in the basin with storage capacities over 5,000 acre feet constructed or under construction. Six are associated with hydroelectric power generation, while they and the remainder provide for water supplies, flood control, irrigation and steam-electric cooling. There are nine steam-electric plants which use water for cooling, drawing a total of 521 mgd. One steam-electric plant is under construction in the basin. Studies are being conducted to identify sources for additional municipal and industrial water supplies, and to evaluate the needs of the area for enhancing water quality, fish and wildlife, and recreation. Fifteen sites have been identified as potential reservoirs for storage, hydroelectric and flood control purposes, and a further five could be developed as hydroelectric projects. There is one retired hydroelectric plant in the basin. Cooling water requirements are expected to reach 9,000 mgd for electricity production of 213,160 GWh in the year 2000. (Brambley-SRC)
W82-01752

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; MENOMINEE RIVER BASIN; MICHIGAN, WISCONSIN,
Federal Energy Regulatory Commission, Chicago, IL. Chicago Regional Office.
S. Sawar, and J. Gage.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0048, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0048, Revised August, 1980. 14 p, 2 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Cooling water, River basins, Licensing, Planning, Utilities, *Menominee River basin, Michigan, Wisconsin.

The Menominee, Peshtigo, Oconto, and Escanaba Rivers, along with the smaller Cedar, Ford, and White Fish Rivers, all discharge into the Green Bay portion of Lake Michigan. The average annual rainfall in the basin is about 30 inches, and the average runoff is approximately 12 inches. The river is not subject to destructive floods, and irrigation in the basin is unnecessary. The Menominee River and its tributaries are important water power streams having 20 developments with a total installed capacity of 107,177 kw. A considerable degree of natural flow regulation is provided by the large number of swamps and small lakes in the upper part of the watershed. There are 33 existing hydroelectric projects, with a total installed capacity of 145,271 kw in the basin. Included in the total are 2 plants that belong to non-Federal, publicly-owned utilities, 7 industrial plants, and 24 privately-owned utility plants. There are also two retired hydroelectric projects. There are five fossil-fueled steam-electric generating stations in the basin, all of which employ once-through cooling. There are five potential hydroelectric development sites in the basin and three potential additions to existing hydroelectric powerplants. There are no rivers in the basin area included in the Federal Wild and Scenic River Act, but some of the rivers fall within State wild river programs. There are no pumped storage projects or potential sites in the basin area. There are also no known steam-electric generating

plants proposed for future construction. (Moore-SRC)
W82-01753

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; LOWER RED RIVER BASIN; ARKANSAS, LOUISIANA, OKLAHOMA AND TEXAS,
Federal Energy Regulatory Commission, Fort Worth, TX. Fort Worth Regional Office.
P. McKee.
Planning Status Report FERC/DOE-0045-6, Revised 1980. 14 p, 3 Fig, 5 Tab.

Descriptors: *Water resources development, *Cooling water, *Hydroelectric power, *Water use, Reservoirs, Consumptive water use, Navigation, Channel improvement, *Red River basin, Arkansas, Louisiana, Oklahoma, Texas.

The Lower Red River basin excludes the Little River and the Ouachita-Black River basins, and is the remainder of the Red River drainage area from below Denison Dam to the Red River juncture with the Mississippi River. Average annual precipitation varies from about 37 inches in the west portion to over 59 inches in the lower east portion. Thirteen major reservoirs, each with a total storage capacity in excess of 70,000 acre-feet, exist or are under construction in the basin. There is no existing hydroelectric capacity in the basin. There has been considerable development in the basin, other than reservoirs, in the interest of flood control, drainage, and bank stabilization. There are 12 fossil-fueled steam-electric generating plants, with capacities of 25 mw or greater, in the basin. The estimated condenser cooling water withdrawn from the sources totaled 29 mgd and the estimated consumption was 13 mgd. Six preliminary permit applications are pending for hydroelectric projects in the basin. There are 12 potential storage reservoirs in the Lower Red River basin. The River and Harbor Act of 1968 authorized the Red River Waterway. The 5 locks downstream from Shreveport are designed to provide a slack water channel 9 ft deep and 200 ft wide from the Mississippi River to Shreveport. The existing channel will be realigned and stabilized as necessary to develop and maintain an efficient navigable channel. Projected steam-electric generation cooling water needs in the basin for 1985 are 57 mgd withdrawn and 33 mgd consumed. (Moore-SRC)
W82-01754

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; KENNEBEC RIVER BASIN, MAINE.
Federal Energy Regulatory Commission, New York. New York Regional Office.
Planning Status Report FERC-0045/3, Revised 1980. 15 p, 2 Fig, 4 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Water use, *Reservoirs, Recreation, Industrial water, Water pollution sources, Pulp and paper industry, Navigation, *Kennebec River basin, Maine.

The Kennebec River basin is located in the west central portion of Maine. The total area of the watershed is approximately 5,900 sq mi and constitutes about 18% of the total area of Maine. Annual precipitation over the basin averages about 42 in. with over 50 in. at the higher headwater elevations. Forest products production activities such as logging, wood transportation, and pulp and paper manufacturing dominate land and water use in this area. The Kennebec River basin is a multiple water use area with impoundments used for power generation, industrial water supply, and recreation. There are 17 existing water power installations in the basin with a total installed capacity of 215,620 kw. There are no existing Federal reservoir projects in the Kennebec River basin and none are authorized. Commercial navigation is carried on in the 45 mile tidal portion of the Kennebec River. Pulp and paper mills, the prime cause of water quality degradation, are presently constructing pollution abatement facilities throughout the basin. There are no steam-electric plants located in the area. There are 20 potential hydroelectric developments in the Kennebec River basin, but none is authorized for construction. There are 32 retired hydro plants in the basin with a total capacity of 7,300 kw. (Moore-SRC)
W82-01755

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; CUMBERLAND RIVER BASIN; KENTUCKY-TENNESSEE.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0077, Revised February, 1981. 19 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Cumberland River basin, Reservoirs, Flood control, Recreation, Water quality control, Wild rivers, Cooling water, Planning, Kentucky, Tennessee.

This revised report presents updated information on the water resources of the Cumberland River Basin, and information on new and planned developments. There are 10 reservoirs used for hydroelectric power generation, although they also have flood control and recreation functions, and there are eight smaller reservoirs used for flood control, recreation and water quality control. The total hydroelectric installed capacity is 945,860 kw. There are four steam-electric generation plants in the basin, withdrawing 1,645 mgd of cooling water from the Cumberland River. Studies are being conducted on additional flood control, water supply, water quality, erosion control, harbors and waterways, conservation and recreation measures on the Cumberland and its tributaries. There are eight potential hydroelectric power sites and seven retired sites. Designation of segments of the Cumberland River and its tributaries as a National River and Recreation Area or Kentucky Wild Rivers will preclude some of the potential developments. Projected cooling water requirements are estimated to be 1,846 mgd by 2000. (Brambley-SRC)
W82-01756

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; TOMBIGBEE-WARRIOR RIVER BASIN; ALABAMA-MISSISSIPPI.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0078, Revised February, 1981. 17 p, 3 Fig, 7 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, Tombigbee River, Warrior River, Locks, Dams, Reservoirs, Recreation, Water supply, Flood control, Storage capacity, Cooling water, Wild rivers, Planning, Navigation, *Tombigbee-Warrior River basin, Alabama, Mississippi.

This revised report presents updated information on the water resources of the Tombigbee-Warrior River Basin, and information on new and planned developments. All but four of the 18 locks on the rivers have been eliminated or replaced by a series of dams and locks. Construction on the Tennessee-Tombigbee Waterway project is continuing. There are 8 existing storage reservoirs, primarily for recreation and water supply, but three have hydroelectric powerplants which have an installed capacity of 242,625 kw. One of the storage reservoirs also provides flood storage capacity. The six steam-electric generating plants withdraw 1,801 mgd of water from the rivers for cooling purposes. There are six hydroelectric projects with preliminary permits outstanding. The West Fork of the Sipsey Fork and its tributaries have been included in the National Wild and Scenic Rivers System, and other rivers are being considered for inclusion. Seven potential water resource developments have been identified which would provide an additional 271,000 kw of installed capacity. Projected cooling water requirements are estimated to be 878 mgd by 2000. (Brambley-SRC)
W82-01757

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; BLACK RIVER BASIN, NEW YORK.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation.
Planning Status Report FERC-0081, Revised March, 1981. 14 p, 3 Fig, 5 Tab.

Descriptors: *Hydroelectric plants, *Water resources development, *Black River basin, New York, Reservoirs, Water storage, Wild rivers, Flood control, Water pollution control, Recreation, Planning.

This revised report presents updated information on the water resources of the Black River Basin, and information on new and planned developments. There are 11 major reservoirs in the basin, with a total storage capacity of 183,000 acre-feet. The usable storage is diverted to the New York State Barge Canal via the Black River Feeder Canal System, or used for downstream hydroelectric power generation. There are 25 existing hydroelectric power installations in the basin having an installed capacity of 103,375 kw. Ten potential hydroelectric project sites have been identified and there are 21 retired hydroelectric projects which have potential for redevelopment. While none of the rivers in the basin are included in the National Wild and Scenic Rivers System, two river segments are included in the Nationwide Rivers Inventory, and these segments are included in the New York State Wild and Scenic Rivers System, and other segments are being studied for inclusion. Other needs of the Black River Basin have been identified as pollution abatement, flood control, recreation, and storage for streamflow regulation. (Brambley-SRC)
W82-01758

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; GRAND RIVER BASIN, MICHIGAN,
Federal Energy Regulatory Commission, Chicago, IL. Chicago Regional Office.
W. Pawlikowski.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0065, Price codes: A02 in paper copy, A01 in microfiche.
Planning Status Report FERC-0065, Revised November, 1980. 12 p, 3 Fig, 4 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Grand River basin, Michigan, Lake Michigan, Cooling water, Groundwater, Flood control, Financial feasibility, Reservoirs, Nonstructural alternatives, Planning, Navigation, Diversion.

This revised report presents updated information on the water resources of the Grand River Basin, and information on new and planned developments. There are seven hydroelectric plants in the basin with a total installed capacity of 6,134 kw, and another 28 retired plants with an installed capacity of about 12,000 kw. The four steam-electric plants in the basin withdraw 140.3 mgd of water for cooling purposes. Three mgd is drawn from wells; the remainder is drawn from the Grand River. Studies have shown that while flood control by use of reservoirs is feasible in the basin, and that significant flood control benefits would result, reservoirs built solely for this purpose are not economically feasible. Public opinion is against multiple-use reservoirs, so flood control will be achieved by nonstructural measures: flood forecasting, flood plain regulation, floodproofing, and permanent evacuation of flood plains. There are four potential hydroelectric power sites in the basin, and one which could be enlarged, to add 18,700 kw of installed capacity. Studies are being conducted to determine the effects of increased Lake Michigan diversions at Chicago, and the feasibility of extending navigation year round. (Brambley-SRC)
W82-01759

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING; POTOMAC RIVER BASIN; PENNSYLVANIA, MARYLAND, WEST VIRGINIA, VIRGINIA, AND DISTRICT OF COLUMBIA,

Federal Energy Regulatory Commission, New York. New York Regional Office.
C. Goggins.
Planning Status Report FERC-0047, Revised 1980. 15 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Potomac River basin, Storage reservoirs, Flood control, Water supply, Recreation, Water quality, Cooling water, Wild rivers, Strip mine wastes, Planning, Mine drainage, Pennsylvania, Maryland, West Virginia, Virginia, District of Columbia.

This revised report presents updated information on the water resources of the Potomac River Basin, and information on new and planned developments. There are 12 water storage reservoirs in the basin with capacities of over 5,000 acre-feet, used for water supply, flood control, recreation and water quality, and there are many smaller flood protection projects. The nine existing hydroelectric installations have a total installed capacity of 11,522 kw. Surface water provides the 2.6 billion gal of cooling water withdrawn daily by the 11 steam-electric plants in the basin. Segments of the Potomac and its tributaries are being considered for inclusion in the National Wild and Scenic Rivers System. Studies are being conducted on the effects of strip mining operations on the rivers, and on possible solutions to abandoned mine drainage problems. Fourteen potential hydroelectric sites have been identified, three of which will also function as storage reservoir sites. An additional 12 sites have been identified for storage reservoirs. Cooling water withdrawals are estimated to be 2.55 billion gal/day in 2000. (Brambley-SRC)
W82-01760

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: UPPER ARKANSAS RIVER BASIN; COLORADO, KANSAS, AND NEW MEXICO.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0060, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0060, Revised August, 1980. 19 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Arkansas River basin, Reservoirs, Flood control, Water supply, Irrigation, Diversion structures, Dams, Cooling water, Wells, Colorado, Kansas, New Mexico.

This revised report presents updated information on the water resources of the Upper Arkansas River Basin, and information on new and planned developments. Reservoir development in the basin has been primarily for flood control with some hydroelectric development. The Trinidad Lake project for flood control, and the Pueblo Dam and Reservoir for flood control, hydroelectric power, water supply, and irrigation are completed. There are five hydroelectric projects in the basin, complete or under construction, with a total installed capacity of 207,310 kw. The Pueblo Reservoir is the terminal reservoir of the Fryingpan-Arkansas project which consists of facilities designed primarily to divert water from the Western Slope of the Rocky Mountains to the water-short areas on the Eastern Slope. The major facilities are six storage dams and reservoirs, 16 diversion structures, and nine tunnels. There are 15 steam-electric plants in the basin, with an installed capacity of 2,921,000 kw, which withdrew 66 mgd of water from the rivers or wells for cooling purposes. This volume is expected to rise to 69 mgd in 2000. There are nine potential sites for hydroelectric power development, with a total installed capacity of 269,200 kw. There is potential for pumped storage development, and potential for further flood control measures. (Brambley-SRC)
W82-01761

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; WESTERN GREAT LAKES TRIBUTARIES; MICHIGAN, WISCONSIN, INDIANA AND ILLINOIS.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Planning Status Report FERC-0045-1, Revised 1980. 17 p, 3 Fig, 7 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Great Lakes tributaries, Water pollution, Lake Michigan, Reservoirs, Cooling water, Navigation, Planning, Water pollution sources, Wilderness areas, Natural waters, Rivers, Michigan, Wisconsin, Indiana, Illinois.

This revised report presents updated information on the water resources of the Western Great Lakes Tributaries, and information on new and planned developments. Pollution is becoming a problem in the water resources of the area, with Lake Michigan most seriously affected. Domestic and industrial wastes are the prime pollutant source, but agricultural and urban runoff are significant. There are 16 hydroelectric projects in the area and six reservoirs for storage purposes only. There are 24 steam-electric plants with an installed capacity of 11,421 MW, which withdraw a total of 6,826 mgd of water for cooling purposes. Studies are being conducted to determine the feasibility of extending navigation year-round in the Great Lakes, and on a number of channel and harbor improvements. Seven sites have been identified as potential hydroelectric sites, and there are 23 retired sites which may have potential for redevelopment. Federal and State Natural Areas, State Wilderness Areas and State Natural Rivers designations, actual and potential, will preclude hydroelectric power development. Cooling water requirements are expected to be 2,296 mgd by 2000. (Brambley-SRC)
W82-01762

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: PENOBSCOT RIVER BASIN, MAINE,
Federal Energy Regulatory Commission, New York. New York Regional Office.
M. Janiszewski.
Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0056, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0056, Revised August 1980. 14 p, 2 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Cooling water, Water demand, Water use, Water storage, Consumptive water use, Planning, *Penobscot River basin, Maine.

The Penobscot River basin is the largest in Maine and the second largest in New England. The average annual precipitation in the basin is 41 inches. There is an abundance of water storage facilities in the basin in the form of lakes, reservoirs, and ponds. There are 20 existing hydropower developments in the basin including five storage projects that regulate streamflow for the benefit of downstream hydropower generation. The developments have a total installed capacity of 152,227 kw. The capacity includes 30,870 kw as the equivalent of 41,388 horsepower in mechanical drive units. The oil-fired Graham Station is the only steam-electric plant located in the basin. The average amount of water withdrawn for 1977 was 1.4 mgd with negligible consumption. There are no potential reservoirs or power projects in the basin which have been authorized for Federal construction. There are significant potentials for hydroelectric power developments. In addition, the 21 retired hydroelectric projects have potential for redevelopment due to changing economic and environmental considerations. The Allagash Wilderness Waterway is a component of the Wild and Scenic Rivers System, but affects no known potential hydroelectric power development. The East and West Branches of the Penobscot River have been under study for inclusion in the system, which would preclude future development of hydroelectric power in the East and West Branches. In 1985, the cooling water withdrawn by Graham Station is estimated at 19 mgd with negligible consumptive use. The estimated annual cooling water withdrawal for steam electric generation in 2000 is estimated at 111 mgd and consumptive use at 1 mgd. (Moore-SRC)
W82-01763

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING: ALTAMAHA RIVER BASIN, GEORGIA,
Federal Energy Regulatory Commission, Atlanta, GA. Atlanta Regional Office.
R. Crisp, and W. Duke.
Planning Status Report FERC-0055, Revised August, 1980. 13 p, 2 Fig, 9 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Cooling water, *Water demand, Water supply, Industrial water, Flood control, Consumptive water use, Water use, Waste disposal, *Altamaha River basin, Georgia.

The Altamaha River, which drains an area of 14,564 sq mi entirely within Georgia, is formed by the confluence of the Ocmulgee and Oconee Rivers 137 mi above the mouth. The average annual precipitation over the basin is approximately 48.9 in. Several of the basin's major industries such as pulp and paper, mineral processing, textiles, chemicals, and food processing place heavy demands upon water resources, either for supply or waste disposal. Existing water resources developments within the Altamaha basin include 17 relatively small flood prevention reservoirs developed by the Soil Conservation Service; 5.5 mi of flood protection works at Macon; the unlicensed, non-Federal run-of-river hydroelectric developments at Milstead, Juliette, Snapping Shoals, and Barnett Shoals; and four licensed non-Federal hydroelectric developments. The 8 hydroelectric projects within the basin have a total installed capacity of 389,532 kw. The four retired hydroelectric projects have a total installed capacity of 6,230 kw. Water supply for municipal use is obtained principally from surface water sources. There are two fossil-fueled and one nuclear-fueled stream-electric plants with a total generating capacity of 3,627 mw. The estimated 1978 total cooling water withdrawn is 851 mgd, and the total consumption is 23 mgd. Plant Scherer is the only steam-electric plant being constructed in the basin. The estimated total cooling water withdrawal is 29 mgd, and consumption is 19 mgd. There is substantial undeveloped hydroelectric power potential in the Altamaha River basin. Certain segments of rivers within the basin have been proposed for consideration for inclusion in the National Wild and Scenic Rivers System. (Moore-SRC)
W82-01764

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING; SANTEE RIVER BASIN; SOUTH CAROLINA-NORTH CAROLINA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Planning Status Report FERC-0073, Revised March 1981. 17 p, 3 Fig, 7 Tab.

Descriptors: *Water resources development, *Hydroelectric plants, *Santee River basin, Diversion channels, Harbors, Shoals, Dredging, Flow rates, Cooling water, Planning, Navigation, North Carolina, South Carolina.

This revised report presents updated information on the water resources of the Santee River Basin, and information on new and planned developments. There are 39 existing hydroelectric projects in the basin, and one under construction, with a total installed capacity of 1,858,426 kw. The plant underconstruction is the St. Stephen project, part of the Cooper River Rediversion project. This project will return much of the flow of the Santee River to its original channel instead of the diverted route into the Cooper River. The aim is to reduce the shoaling problem and increased dredging of Charleston Harbor which resulted from the greatly increased flow following the diversion. There are 23 potential hydroelectric projects in the basin and 43 retired hydroelectric sites which have potential for redevelopment. Four of these sites are being investigated. There are 11 steam-electric plants which withdraw 2,182 mgd of water for cooling purposes; this volume is expected to rise to 3,074 mgd by 2000. Modifications will be made to Charleston Harbor to construct and maintain a 40 ft depth, and a 38 ft navigation channel will be

dredged and maintained on the Shipyard River. (Brambley-SRC)
W82-01765

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING: TENNESSEE RIVER BASIN; VIRGINIA-TENNESSEE-NORTH CAROLINA-MISSISSIPPI, GEORGIA-KENTUCKY-ALABAMA.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Planning Status Report FERC-0074, Revised March 1981. 15 p, 3 Fig, 6 Tab.

Descriptors: *Water resources development, *Tennessee River basin, *Hydroelectric plants, Flood control, Navigation, Cooling water, Water use, Wild rivers, Resources management, Virginia, Tennessee, North Carolina, Mississippi, Georgia, Kentucky, Alabama.

This revised report presents updated information on the water resources of the Tennessee River Basin, and information on new and planned developments. The estimated population of the area in 1978 was 3,600,000. There are 48 existing hydroelectric projects within the Tennessee River Basin, providing a total installed capacity of 5,333,050 kw. Twenty-nine are projects of the Tennessee Valley Authority (TVA), with a capacity of 4,794,250 kw. The TVA projects are operated primarily for flood control and navigation and produce over 16 billion kwh of electricity. There are nine steam-electric generating plants in the basin, with cooling water withdrawal rates of 4,790 mgd. There are six outstanding Federal Energy Regulatory Commission licenses covering nine developments and eight applications pending covering ten developments. The Obed River and its tributaries have been made part of the National wild and Scenic rivers System, and the Nolichucky River is being studied for inclusion. A comprehensive inventory of all water and land resource projects, complete, in progress, or proposed, is being conducted to aid in the increased coordination among the various agencies involved with water resource management. Seventeen potential water resource developments for flood control, hydroelectric power or other purposes are identified and 32 sites, now closed, are identified as potential hydroelectric power sites. The Tennessee-Tombigbee Waterway project is scheduled for completion in 1986. (Brambley-SRC)
W82-01766

WATER RESOURCES APPRAISALS FOR HYDROELECTRIC LICENSING, SAGINAW AND AU SABLE RIVER BASINS AREA, MICHIGAN.
Federal Energy Regulatory Commission, Washington, DC. Office of Electric Power Regulation. Available from the National Technical Information Service, Springfield, VA 22161 as FERC-0061, Price codes: A02 in paper copy, A01 in microfiche. Planning Status Report FERC-0061. Revised 1980. 12 p, 2 Fig, 5 Tab.

Descriptors: *Water resources development, *Hydroelectric power, *Cooling water, *Wild rivers, River basins, Thermal powerplants, Licensing, *Saginaw River basin, Au Sable River basin, Michigan, Lake Huron.

The Saginaw and Au Sable River basins area lies entirely within Michigan on the west shore of Lake Huron and comprises approximately 3% of the Great Lakes drainage area. Annual rainfall in the basin averages about 28 inches. The average discharge of the Saginaw River at its mouth is about 4,000 cu ft/s, while the average discharge of the Au Sable is about 1,700 cu ft. There are 11 existing hydroelectric powerplants in the Saginaw and Au Sable River basins with a total installed capacity of 52,160 kw. All of the powerplants are owned and operated by investor-owned utilities except for the 360 kw St. Louis plant on the Pine River. There are seven fossil-fuel steam-electric generating stations in the Saginaw and Au Sable River basins, and a nuclear steam-electric plant under construction. All but two of the fossil-fueled plants employ once-through cooling. The Au Sable River is presently under study for inclusion in the National Wild and Scenic Rivers System. Four potential hydroelectric power developments and the possible addition to an existing project would be prohibited by wild and scenic river designation. The total estimated capacity foregone would be an estimated 58,700 kw and an average annual generation output of about 163,900,000 kwh. (Moore-SRC)
W82-01767

ADDENDUM TO: SOURCES OF POWER-PLANT COOLING WATER IN THE DESERT AREA OF SOUTHERN CALIFORNIA--RECONNAISSANCE STUDY,
Geological Survey, Menlo Park, CA. Water Resources Div.
For primary bibliographic entry see Field 6B.
W82-01773

HYDROPOWER VS. SALMON: THE STRUGGLE OF THE PACIFIC NORTHWEST'S ANADROMOUS FISH RESOURCES FOR A PEACEFUL COEXISTENCE WITH THE FEDERAL COLUMBIA RIVER POWER SYSTEM,
Lewis and Clark Coll. Portland, OR. Northwestern School of Law.
For primary bibliographic entry see Field 6E.
W82-01804

FOOD AND ENERGY PRODUCTION: CONJUNCTIVE WATER PLANNING,
Wright Water Engineers, Inc., Denver, CO.
For primary bibliographic entry see Field 3C.
W82-01856

PRESERVING INSTREAM FLOWS IN OREGON'S RIVERS AND STREAMS,
For primary bibliographic entry see Field 6E.
W82-01871

GULF OF MEXICO: A SOCIOECONOMIC VIEW OF COMPETING RESOURCES,
For primary bibliographic entry see Field 6B.
W82-01901

PERSEVERANCE PRODUCES COUNTY PARK,
York Water Co., PA.
W. T. Morris.
Public Works, Vol 111, No 3, p 62-63, March, 1980.

Descriptors: *Legal aspects, *Parks, Recreation facilities, Public lands, Reservoirs, Management planning, Decision making, Planning, Conjunctive use, Case studies, Pennsylvania.

Copperation between government and private enterprise produced success in the William H. Kain County Park, located in York County, Pennsylvania. An agreement was reached between the water company and the commissioners of the area which allowed the county to use free of charge the reservoir lands and waters of both lakes which serve as impoundments for the water company. The agreement specifies that although the area is to be used for recreational purposes, the prior and overriding use is for water utility purposes. No activity is permitted which would in any way interfere with that use. In return for this usage, the county agreed not to erect a dam, lake or impoundment, or otherwise obstruct the flow of the East Branch of Codorus Creek and tributaries upstream from Lake Redman. A supplemental agreement was also issued which licensed the county to use about 400 to 500 acres of other company lands for recreational purposes under the same conditions. Many problems remained involving legal language, and various suggestions were made to surmount these difficulties. Finally, acceptable agreements were reached. (Baker-FRC)
W82-01932

WATER QUALITY AND THE DEMAND FOR RECREATION,
Illinois State Univ., Normal. Dept. of Economics.
G. Blomquist, and G. Fishelson.
International Journal of Environmental Studies, Vol 14, No 4, p 317-321, 1980. 2 Tab, 12 Ref.

Descriptors: *Water quality, *Recreation demand, *Parks, Regression analysis, *Illinois, Dissolved oxygen, Coliforms, Economic aspects, Evaluation.

Weak responses in demands for recreation were detected for changes in water quality parameters. The attendance at 74 Illinois state parks and recreation areas in 1976 was analyzed. Variables employed were water quality, facilities, nonwater attributes, and distance. Regression analysis showed that the number of annual visits depends on travel costs, price of complements and substitutes, attributes of the park (museums, boating, horseback riding, and hunting), and water quality. Dissolved oxygen was not significant at any reasonable level, but fecal coliforms above 200 per ml was significant at the 90% level. The shortcomings of this analysis were: (1) length of visitor stay was not considered, (2) water quality data was not sufficiently detailed, and (3) annual median water quality was used, not seasonal values. (Cassar-FRC)
W82-01942

LOGISTICS OF FARM WATER SUPPLY.
For primary bibliographic entry see Field 6A.
W82-02037

WANTED: WATER FOR DEVELOPMENT,
P. Harrison.
Ambio, Vol 9, No 3-4, p 202, 1980.

Descriptors: *Developing countries, *Water supply development, *Sanitation, *Public health, Human diseases, International Drinking Water and Sanitation Decade, United Nations, Water pollution effects.

An investment of 140,000 million dollars will be required over ten years to meet the goals set by the International Drinking Water and Sanitation Decade. A World Health Organization survey in 1975 found that three out of every five people in poor countries were without adequate water, and two out of three had inadequate sanitation. Illness and infant mortality in the Third World is due in large part to this situation. Better water and sanitation can cut skin and eye infections and diarrhea from 50 to 100%. Schistosomiasis can cut workers' productivity by 15 to 80%, and malaria is a major cause of absenteeism at work and at school. Both of these are water related diseases. The situation in Bangladesh is improving after the installation of 50,000 tubewells, but only one house in 20 has a sanitary latrine. To reach the 1990 goal, Third World countries will have to divert more resources to rural areas, which contain two thirds of the population but have received only 17% of the investment in water and sanitation. (Small-FRC)
W82-02088

6E. Water Law and Institutions

PARISH IS NOT LIABLE FOR SUBSIDENCE.
Public Works, Vol 112, No 9, p 64-65, September, 1981.

Descriptors: *Dredging, *Legal aspects, Subsidence, Canals, Maintenance, Land tenure, Land rights, Liability, *Drainage canals, *Louisiana.

A drainage canal was dredged in Louisiana, with the result that a property owner brought suit for damages for loss to his property. The canal crossed and bounded his land. The land owner claimed that as a result of the dredging, his land was subject to both erosion and subsidence. The solid land, it was claimed, applied pressure and the silt below oozed out. The trial court entered a judgment for the defendant, finding no causal connection between the depth of the Bayou and the subsidence. Another court did find a causal connection, claiming that a relationship did exist between the piercing of the clay layer and subsidence. However, the Court could not find the Parish either negligent nor strictly liable. Proof was provided that the canal had not in fact been

dredged, but rather had only been brushed clean, without disturbing the clay layer. (Baker-FRC)
W82-01603

THE NATIONAL WATER POLICY REVIEW AND WESTERN WATER RIGHTS LAW REFORM: AN OVERVIEW,
Nebraska Univ., Lincoln.
J. D. Aiken.
Nebraska Law Review, Vol 59, No 2, p 327-344, 1980. 73 Ref. OWRT-C-80138(8412)(1).

Descriptors: *Water policy, *Water rights, *Legal aspects, Nebraska, Colorado, Washington, California, Irrigation water, Water use efficiency, Groundwater management, Water management, Groundwater mining, River regulation, Regulations, Well regulations, Water law, Judicial decisions, Legislation, Western States.

Although economic development has traditionally been accepted as a primary objective in the formulation of state and federal water policies, the achievement of most economic development objectives has resulted in increased public concern regarding the protection and preservation of natural resources. Inconsistent federal water policies have resulted from the enactment of federal environmental legislation which conflicts with existing reclamation, flood control, and hydroelectric power production programs. Water development programs are also being subjected to closer budgetary examinations than in the past. The proposed major objectives of a review and development of a national water resources management policy initiated by President Carter in 1977 included modification of state water laws to meet the environmental protection and water use efficiency objectives. Strong protests by the western states resulted in the elimination of this reform in state water rights laws as an explicit objective. However, several existing innovative water policies adopted by some western states may serve as models for state and federal officials searching for water policy alternatives. These include farm-level irrigation water use efficiency programs in Nebraska; groundwater mining regulations in Nebraska; minimum streamflow legislation in several western states; procedures for resolving conflicts between surface and groundwater users in Colorado; and policies for conjunctive management of groundwater and surface water in Washington and California. These water law developments are described, and their relevance to other western states is evaluated. Social, economic, and political objections to reform objectives constitute the major obstacle to water law reforms. Alternatives which accommodate development as well as reform objectives are both necessary and possible. Better integration of federal water programs is perhaps the most important water policy contribution the federal government could make at this time. (Carroll-FRC)
W82-01659

LEGAL CHALLENGE OF THE UNGAGED WATERSHED,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W82-01664

THE NATIONAL COMMISSION ON WATER QUALITY: A CASE STUDY IN CONGRESSIONAL POLICY ANALYSIS,
Texas Univ. at Dallas, Richardson.
For primary bibliographic entry see Field 6B.
W82-01669

REGULATING THE QUALITY OF DRINKING WATER: AN ECONOMIC ANALYSIS OF THE SAFE DRINKING WATER ACT OF 1974,
Wisconsin Univ.-Madison.
For primary bibliographic entry see Field 5G.
W82-01691

HYDROPOWER VS. SALMON: THE STRUGGLE OF THE PACIFIC NORTHWEST'S ANADROMOUS FISH RESOURCES FOR A PEACEFUL COEXISTENCE WITH THE FEDERAL COLUMBIA RIVER POWER SYSTEM,
Lewis and Clark Coll. Portland, OR. Northwestern School of Law.
M. C. Blumm.
Environmental Law, Vol 11, No 2, p 211-300, Winter, 1981. 461 Ref.

Descriptors: *Water use, *Legal aspects, *Hydroelectric power, *Fisheries, Salmon *Anadromous fish, Hydroelectric plants, Powerplants, *Columbia River, Water demand, Water supply, Resources development, Resources management.

This article documents the inherent conflicts between employing Columbia Basin water projects primarily to maximize power production and preserving the basin's depleted anadromous fish runs. The legislative history of dam authorizations was also surveyed, and no congressional intent was uncovered that hydropower should dominate project operations to the exclusion of the fisheries. There was strong evidence, on the contrary, that Congress intended that hydropower generation and fisheries preservation should coexist. However, the decision making structure in government project operations has overlooked this intent, and fish and wildlife protection has not been given equal consideration in the planning stages. A general overhaul of the decision making structure is needed. A restructing can be accomplished through compliance with the spirit and letter of the National Environmental Policy Act and the Fish Wildlife Coordination Act. Supplying sufficient streamflows to protect anadromous fish runs will necessitate changes in regional hydroelectric consumption. The fundamental issue in this regard is the lack of effective mechanisms designed to modify peak load demands placed on the hydropower resource. More systematic investigation is needed of alternative, less costly ways of simultaneously meeting hydroelectric energy demands and protecting fisheries. The economic value of the salmon produced in the Columbia River makes it essential that some solution to the problem be found before this source of income is extinguished. (Baker-FRC)
W82-01804

STATIONARY SOURCE POLLUTION POLICY AND CHOICES FOR REFORM,
Resources for the Future, Washington, DC.
W. Harrington, and A. J. Krupnick.
Natural Resources Journal, Vol 21, No 3, p 539-564, July, 1981.

Descriptors: *Water pollution control, *Regulations, *Economic aspects, Legal aspects, Political aspects, Effluent standards, Permits, Water law, Water quality standards, Water policy, Environmental effects, Air pollution, Administrative agencies, Cost effectiveness.

Proposed reforms of the water and air pollution policies formulated in the early 1970's are described. Procedural reforms change the procedures used to develop and implement environmental regulations and can reduce costs. Using 2 or 3 contractors to provide background information for a regulation would be initially more costly but, in the long run, might reduce total costs by producing more reliable information and regulations more acceptable to industry. Greater subcategorization (tailor-made regulations for individual industries) could promote competition by preserving some of the older plants and help hold down the inflation rate. On the other hand subcategorization can reduce productivity by preserving obsolete plants. Permit reform measures include extending permit life, improving coordination between federal and state agencies with respect to permits and regulations, establishing a regulatory clearing house, and initiating a one-step permitting process. Cost effectiveness standards would equalize marginal abatement costs and minimize costs of obtaining the resulting reductions in aggregate emissions; this has several problems, however. Innovation waivers could be granted to allow time to work out difficulties in new abatement technologies. Substantive reforms have begun to supplant the technology-based approach in some states and in EPA planning. These include the bubble policy, banking emissions allowances for future expansion or as an offset, marketable pollution permits, and effluent charges. Proponents of these reforms claim that desired environmental quality may be obtained at lower economic costs. Opponents fear that any change represents a retreat from the nation's commitment to environmental quality. (Cassar-FRC)
W82-01847

THE CALIFORNIA STATE WATER PROJECT--CURRENT ACTIVITIES AND FUTURE MANAGEMENT PLANS.
California State Dept. of Water Resources, Sacramento.
Bulletin 132-80, October 1980. 197 p. 12 Fig, 12 Tab, 5 Append.

Descriptors: *Water management, *Comprehensive planning, Structural engineering, Environmental engineering, Canal design, *Multiobjective planning, *Economic aspects, Canal construction, Future planning, Open channels, Legislation, Water policy, Projections, *California.

Legislation that provides a comprehensive plan for meeting the water needs of the State Water Project (SWP) through the year 2000 was approved by the California Legislature in 1980. SB200 authorizes (1) the Peripheral Canal, a proposed 43-mile-long canal to move water across the Sacramento Delta to aqueducts serving southern California; (2) construction of facilities to maintain Suisun Marsh as a habitat for birds and wildlife in the Delta; (3) ground water storage in lieu of comparable surface storage; and (4) additional storage projects in the Sacramento Valley system. Additionally, feasibility studies on enlarging Shasta Dam will be integrated into detailed studies of surface storage alternatives included in SB200. Assembly Constitutional Amendment 90, approved by the Legislature, contains Delta-San Francisco Bay guarantees and protection for the North Coast wild rivers. SWP components and implementation plans for additional segments are discussed in terms of future water supply plants, future costs of water service, negotiations for joint operating agreement of SWP and the federal Central Valley Project, the interagency drainage program, and other matters. Also discussed are future construction costs, operating costs, and project financing descriptions that include construction expenditures, capital requirements, financing, operating revenues, and power costs. Capital requirements through 2000 are estimated at $10.1 billion. Among the steps taken to ensure power supply for the SWP through the year 2000 are the development of 3 geothermal power plants, a geothermal biomass plant, 15 hydroelectric power plants, and contracting for joint ownership of a coal-fired power plant. (Garrison-Omniplan)
W82-01851

POLLUTION CONTROL: CHANGING APPROACHES,
Experimental Research and Technology, Inc., Concord, MA.
S. H. Schroeder.
Environmental Science and Technology, Vol 15, No 11, p 1286-1291, November, 1981.

Descriptors: *Legislation, *Regulations, *Water pollution control, Superfund, Clean Water Act, Federal Water Pollution Control Act, Resource Conservation and Recovery Act, Legal aspects, Permits, Liability, Water quality control, Water quality standards, Effluent standards.

The evolution of pollution control legislation in the past 10 years is discussed. A major difficulty has been the gap between regulations and the scientific knowledge necessary for implementation. Several approaches have been used in formulating pollution control programs. The Federal Water Pollution Control Act (FWPCA), 1972, was technology-based, requiring a minimum level of control according to available technology. This simplified the regulatory process, but did not consider local environmental effects. Ambient water quality standards were then added. The implementation was delegated to the EPA and the states, resulting in a regulatory tangle. In 1977 the FWPCA was

amended and its name changed to the Clean Water Act. The NRDC Consent Decree was adopted, formalizing the technology-based approach, with the exception of exemptions for thermal and publicly owned treatment works effluents in some cases. The Resource Conservation and Recovery Act requires definition of hazardous substances and cradle-to-grave standards of handling, to be implemented by permit. The Act poses great difficulties in decision making for permit writers and is concerned with all aspects of the environment (air, water, etc.). The Superfund, in contrast to previous legislation, is concerned with liabilities. Harmful releases are cleaned up and liabilities assigned to the polluters. Problems arise in assigning liability because of uncertain cause-effect relationships and because of the long time lapse between cause and observed effect in many situations. The fund covers only government cleanup effort costs, not individual damages for death, disease, or property damage. A crucial element in the success of any pollution control program is the ease of implementation, given the uncertainty of knowledge of toxic materials and their effects. The author urges participation by the technical community in legislative and regulatory processes to prevent adoption of unrealistic programs. (Cassar-FRC)
W82-01870

PRESERVING INSTREAM FLOWS IN OREGON'S RIVERS AND STREAMS,
C. C. Sherton.
Environmental Law, Vol 11, No 2, p 379-419, Winter, 1981. 247 Ref.

Descriptors: *Instream flow, *Legal aspects, Water supply development, Water resources development, Water management, Resources management, *Oregon, State jurisdiction.

The growing population and increasing demands of industry in Oregon project ever increasing water needs. However, the availability of water in that state varies greatly by geography and season. This paper examines means to preserve instream flows that are being or could be used within the general structure of Oregon's water laws. The history and basic principles of Oregon water law are reviewed, past and potential use of existing provisions of Oregon water laws in preserving instream flows are examined, several means of preserving instream flow that have been proposed or are in use elsewhere are analyzed for their potential use in Oregon, and an effective and politically feasible strategy is presented for preserving instream flows in Oregon. The current system of planning for the use of water resources in Oregon and the appropriation permit system do not provide adequate protection to instream flows for uses such as fishing, recreation, hydroelectric power, and pollution abatement. Certain administrative and minor statutory changes could improve the operation of the existing system. However, there is a need to recognize water rights for instream uses on a par with water rights for consumptive uses. The major recommendation from this study is that Oregon recognize appropriative water rights for instream uses. Recognition of such rights would in most cases be the most effective means of preserving instream flows in streams which have unappropriated water, and of returning instream flows to streams where all the water has been appropriated for consumptive use. This recognition can be achieved by amending Oregon's statutes governing water permits, and is not incompatible with the appropriations doctrine as developed in Oregon. Only certain agencies should have the power to apply for instream appropriations. (Baker-FRC)
W82-01871

PERSEVERANCE PRODUCES COUNTY PARK,
York Water Co., PA.
For primary bibliographic entry see Field 6D.
W82-01932

THE HAZARDS OF HAZARDOUS WASTE MANAGEMENT,
Maryland Dept. of Natural Resources, Annapolis.
J. B. Coulter.
Industrial Wastes, Vol 26, No 5, p 26, 28-29, September-October, 1980.

Descriptors: *Hazardous materials, *Waste management, *Water pollution sources, Wastes, Waste storage, Incineration, Waste disposal, Groundwater pollution, Organic compounds, Poisons, Toxins, Landfills, *Sharptown, Maryland.

In Sharptown, Maryland, a small business man established an operation to recycle waste oil. After the business failed, it was discovered that the waste oil contained a medley of hazardous substances such as PCBs in concentrations as high as 310,000 ppm. The man was heavily fined, and the townspeople became increasingly alarmed over the possibility of various emergencies arising out of these chemicals. Tests at that time showed no contamination of the groundwater supplies, but there was no test available to verify that contaminating materials were not presently moving through the soil on their way to the groundwater sources. Models were constructed and studies performed to determine the best course of action should any spillage or leakage of materials be noted. A federal-state response team endorsed a decision to move the wastes from Sharptown to some other location where they could be safely stored pending destruction by incineration at an EPA approved facility which would be constructed. After several legal suits and countersuits, the transfer of the hazardous materials was made, and the material is now under constant guard until the incinerators can be completed. It is suggested that hazardous waste managers should take constructive measures, which does not include downplaying the problem or understating the severity of it. Landfills should be avoided if at all possible. Actions which are dangerous must be outlawed. Safe facilities for hazardous waste must be established. A meaningful legal definition of the term hazardous waste is sought. (Baker-FRC)
W82-01940

WATER SANITATION LEGISLATION REGARDED AS THE BASIS OF WATER QUALITY MONITORING,
Institute of General and Municipal Hygiene, Moscow (USSR).
G. N. Krasovsky, N. N. Litvinov, Z. I. Zholdakova, and L. J. Vasiukovitch.
Water Science and Technology, Vol 13, No 7, p 391-392, 1981.

Descriptors: *Water quality standards, *Reservoirs, *Effluent standards, Legal aspects, Regulations, Legislation, Water supply, Standards, Drinking water, Multipurpose reservoirs, Monitoring.

A unified three-element regulatory system for water quality monitoring is suggested for guaranteeing the safety of drinking water from open reservoirs used for domestic and recreational purposes. The three parts are: drinking water standards, water reservoir quality standards, and sewage effluent conditions. Each part states a maximum allowable concentration. Toxicological, organoleptic, and epidemiological criteria must be added to the conventional water reservoir quality standards to ensure safety. (Cassar-FRC)
W82-01990

STREAMLINED REGULATIONS COULD HELP MAKE NEW STORMWATER MANAGEMENT CONCEPTS PART OF THE TRADITION,
For primary bibliographic entry see Field 4A.
W82-02000

REGULATION FOR ENVIRONMENTAL PROTECTION: THE NANTICOKE INDUSTRIAL COMPLEX, ONTARIO, CANADA,
Waterloo Univ. (Ontario). Dept. of Geography.
J. G. Nelson, J. C. Day, and S. Jessen.
Environmental Management, Vol 5, No 5, p 385-395, September, 1981. 1 Fig, 3 Tab, 41 Ref.

Descriptors: *Environmental protection, *Regulations, *Industrial plants, Monitoring, Economic aspects, Industrial wastes, Water pollution sources, Water pollution effects, *Lake Erie, Canada.

The effectiveness of the environmental protection regulatory system for the $2.2 billion iron and steel plant, oil refinery, and thermal generating station planned for the Nanticoke Industrial Complex was evaluated. Literature reviews and environmental impact studies performed by various industries and government agencies were assessed. In general, the project and its various impacts were regulated and managed reasonably efficiently and without significant known impacts to date. Industry has suggested that the costs of the environmental controls have been too high. In the future, continuous monitoring, more comprehensive research, and better overall environmental management will be required if the benefits of Nanticoke are not to be achieved at potentially avoidable costs to fishing, agriculture, and tourism. Attention must be paid to the accumulative impact of the complex. (Small-FRC)
W82-02024

THE SEWERAGE POLICY OF THAMES WATER,
Thames Water Authority (England).
J. L. Dakers.
Effluent and Water Treatment Journal, Vol 20, No 1, p 29-31, January, 1980. 2 Tab.

Descriptors: *Sewerage, *Thames Water Authority, *Water policy, *Priorities, Wastewater treatment, Capital costs, Water quality, Great Britain.

The Thames Water Authority provides water services for 12 million people over an area of 13,100 sq km. Sewerage tasks are mostly performed by the district councils under contract with the Authority. In view of limited resources, a table of priorities for capital expenditures was established. There are five classes. Class one concerns public health, expansion in housing and industry. Class two involves maintaining or replacing existing systems and allowing for increased demand by present consumers. Classes three, four, and five concern improvements in service and water quality and first time services. Details of the Water Authority responsibilities are given. Alternatives in selecting a sewage disposal system and the policies for first time sewerage are presented. (Cassar-FRC)
W82-02040

STRUCTURAL ASPECTS OF THE WATER SUPPLY IN THE FEDERAL REPUBLIC OF GERMANY,
Verband der Deutschen Gas- und Wasserwirtschaft e.V./Deutscher Verein des Gas und Wasserfaches e.V., Bonn (Germany, F.R.).
H-J. Arens.
Aqua, No 1, p 13-14, 1981.

Descriptors: *Water management, *Political aspects, *Federal Republic of Germany, *Water supply, Water resources development, Water use, Germany.

Political and legal aspects of the water supply system in the Federal Republic of Germany are discussed, together with some general aspects of water production and water utilization. Federal German legislative power in the field of water management is limited to basic regulations. Individual Laender, or states, are charged with granting approvals and licenses for water use, protecting waters against pollution and rehabilitating polluted waters, and establishing water management plans. Local authorities are responsible for securing water supplies for their areas and disposing of waste waters. Although there are about 7,300 public water supply undertakings in the country, about 55 percent of the water quantity delivered is produced by a very few large undertakings. About 52 percent of the water is delivered by municipally-owned waterworks, with joint stock companies and private limited companies delivering the rest. There is increasing cooperation between neighboring communities in water supply management. Cooperation in the form of long-distance water suppliers is also becoming more common. Over 60 percent of the total production of the public water supply comes from groundwater, although there is a tendency to produce more surface water in congested areas. While consumption of public water

supplies by households and small businesses increased by 36 percent from 1970 to 1979, use by industry dropped by about 25 percent, largely as the result of increased recycling of water and other water conservation measures. In addition, industry produces large quantities of water for its own supply. Competition between the public water supply and industry for water resources is increasing, requiring more regional planning of water management. (Carroll-FRC)
W82-02066

STREAM POLLUTION IN HONG KONG - AN APPRAISAL,
Hong Kong Univ. Dept. of Botany.
For primary bibliographic entry see Field 5B.
W82-02084

INTERNATIONAL COOPERATION TO PROTECT THE BALTIC,
Ministry of Agriculture, Stockholm (Sweden). Environmental Div.
B. Hagerhall.
Ambio, Vol 9, No 3/4, p 183-186, 1980. 10 Ref.

Descriptors: *International commissions, *Baltic Sea, *Environmental protection, Organizations, Water pollution control, Pollution prevention, DDT, Polychlorinated biphenyls.

The Convention on the Pollution of the Marine Environment of the Baltic, one of the most comprehensive environmental agreements ever ratified, was signed by all of the Baltic states in 1974 and went into effect in 1980. The Convention covers discharges from land-based sources, including air pollution, discharges from ships, dumping of wastes, and international cooperation to combat spillages of oil and hazardous substances at sea. The Baltic Marine Environmental Protection Commission was established by the Convention. Its purpose is to recommend measures relating to the purposes of the Convention, recommend amendments to the Convention, define pollution control criteria and objectives, and promote scientific and technological research. Current goals of the Commission are to draft a prohibition of the use of DDT, to regulate or prohibit PCB discharge and use, and conduct scientific evaluations on the present state of pollution of the Baltic by PCBs, mercury, cadmium, lead, copper, zinc, and their compounds. Oil emissions and environmental quality guidelines are also areas of current concern. (Small-FRC)
W82-02087

6F. Nonstructural Alternatives

EFFLUENT FEES, AN ALTERNATIVE SYSTEM FOR ACHIEVING WATER QUALITY: A CASE STUDY,
Auburn Univ., AL. Dept. of Economics.
A. N. Link, and F. A. Scott.
Water Resources Bulletin, Vol 17, No 3, p 498-500, June, 1981. 4 Tab, 8 Ref. OWRT-A-074-ALA(2), 14-34-0001-0101.

Descriptors: *Water quality control, *Effluent charges, *Black Warrior River, *Alabama, Costs, Water pollution control, Economic aspects, Industrial wastes, Municipal wastes.

The effluent fee system and the uniform standards system of water quality control were compared for a 30-mile section of the Black Warrior River, Alabama, which receives discharges from 6 major industries and 2 municipalities. Using BOD removal as a basis and an effluent fee of $0.0587 per pound BOD discharged, the polluters would have to remove 47,593 pounds BOD er day to meet the same water quality standards as under the uniform standards system. However, 2 of 6 firms would find it cheaper to remove zero BOD, 2 firms and 1 municipality would find it cheaper to remove less BOD, and 2 firms and 1 municipality would find it cheaper to remove more BOD than under the present uniform standards system. Total daily cost for all 8 dischargers is $1224.50 under the effluent fee system and $1839.50 under the uniform standard system, a difference of $224,475 annualy to achieve the same water quality. (Cassar-FRC)
W82-01665

STANDARDS AND CHARGES IN THE CONTROL OF TRADE EFFLUENT DISCHARGES TO PUBLIC SEWERS IN ENGLAND AND WALES,
York University, Heslington (England). Institute of Social and Economic Research.
For primary bibliographic entry see Field 6C.
W82-01717

FLOODPLAIN MANAGEMENT: A FLOOD AND LAND PLANNING SYSTEM,
Vermont House of Representatives, Montpelier.
M. D. Arnold.
Environmental Conservation, Vol 8, No 2, p 97-106, Summer, 1981. 5 Fig, 21 Ref.

Descriptors: *Flood plain management, *Flood protection, *Flood damage, Legal aspects, Land use control, Political aspects.

Floodplain management, a systematic regime of land and flood management by which floodable areas are turned to uses that are compatible with flooding, is reviewed. By using floodplain management, human trauma and physical damage of floods can be reduced. Man-made developments are kept out of floodplains or are designed to resist or accommodate water damage. Floodplain management is more economic and less socially costly than structures used to control flooding. Flood management tools include: citizen intervention, regulation, property rights purchase, structures, relocation of settlements, weather forecasting and warning, government loan and guarantee activities, government flood insurance, private and government disaster aid, banking regulations, farm preservation, erosion control, and water quality management. Political reform is necessary before this approach to floods becomes more general. (Small-FRC)
W82-01872

THE ECONOMICS OF COOPERATION OVER COLLECTIVE BADS,
Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6A.
W82-01909

ECONOMIC INSTRUMENTS FOR CONTROLLING EFFLUENT DISCHARGES TO THE RIVER TEES ESTUARY,
Newcastle upon Tyne Univ. (England). Dept. of Economics.
For primary bibliographic entry see Field 2L.
W82-02060

INTERNATIONAL COOPERATION TO PROTECT THE BALTIC,
Ministry of Agriculture, Stockholm (Sweden). Environmental Div.
For primary bibliographic entry see Field 6E.
W82-02087

6G. Ecologic Impact Of Water Development

RELATING POPULATION GROWTH TO SHELLFISH BED CLOSURES: A CASE STUDY FROM NORTH CAROLINA,
East Carolina Univ., Greenville, NC. Dept. of Sociology and Anthropology.
For primary bibliographic entry see Field 5C.
W82-01641

A WATER QUALITY ASSESSMENT OF DEVELOPMENT IN THE SENEGAL RIVER BASIN,
Agency for International Development, Washington, DC. Bureau for Africa.
M. S. Gould.
Water Resources Bulletin, Vol 17, No 3, p 466-473, June, 1981. 8 Fig, 2 Tab, 11 Ref.

Descriptors: *Water quality, *Environmental effects, *River basin development, *Senegal River, *Africa, Model studies, Mathematical models, Aquatic life, Dams, Water resources development, Agriculture, Irrigation, Fish, Dredging, Sediment yield, Dissolved oxygen, Estuaries, Saline water barriers.

The impacts of proposed water resources development in the Senegal River basin were studied with mathematical modeling and examination of case histories. This paper concerns the water quality aspect of the environmental assessment, which also draws on nine other major disciplines. Although this basin is relatively undeveloped, analytical techniques for more highly developed basins were successfully used. It was concluded that the proposed development plans should have minor negative impact on water quality in the basin. However, the Diama Dam, built to prevent salt water intrusion into the upper river, will adversely affect spawning of marine and estuarine fish. Dissolved oxygen in the river would remain high and more uniform with the aid of flow regulation. Minimum dissolved oxygen concentrations in the estuary would be lower, reaching a projected 1 mg per liter by 2028. Other projects under consideration are the Manantali Dam for flow regulation and hydropower, irrigated agriculture, dredging for improved navigation, and industrial and municipal development. The reservoir created by Manantali Dam will initially be eutrophic due to nutrient releases and organic matter from inundation of 480 sq km of savanna forest. For the first few years aquatic vegetation could be a nuisance, and fish productivity would be high. The low dissolved oxygen concentration in the first 20 km of river below the dam would be hazardous to aquatic life. Similar lakes in Africa usually take about 5 years to evolve into a mesotrophic state. Agricultural fertilizers and pesticides will have a minor impact on water quality if proper practices are used. Dissolved solids in the river should not increase beyond 150 mg per liter with proper irrigation practices. (Cassar-FRC)
W82-01740

IMPACTS OF NAVIGATIONAL DREDGING ON FISH AND WILDLIFE: A LITERATURE REVIEW,
Fish and Wildlife Service, Washington, DC. Office of Fishery Assistance.
K. O. Allen, and J. W. Hardy.
Available from the National Technical Information Service, Springfield, VA 22161 as PB81-137853, Price codes: A05 in paper copy, A01 in microfiche. Report FWS/OBS-80/07, September, 1980. 88 p, 7 Fig, 228 Ref, Append.

Descriptors: *Dredging, *Literature review, *Fish, *Wildlife, *Environmental effects, Navigation, Water pollution, Channel improvement, Estuaries, Habitats, Hydrology, Ecosystems, Ecological effects.

This review covers impacts to fish, other aquatic organisms, and wildlife, as well as habitat enhancement opportunities, resulting from construction of new navigational channels and maintenance dredging of existing channels. The type of dredging equipment used determines, to a great extent, the viable disposal alternatives, the type and magnitude of potential impacts, and the potential for habitat development. About 99% of the dredging volume in the U.S. is accomplished by hydraulic dredges. The composition of dredged material from a particular site affects its pollution potential as well as the potential for habitat development or other beneficial uses. Dredged material from new channels or new works projects often has chemical and engineering properties which create fewer environmental problems than material from maintenance projects. Material removed during maintenance dredging of navigational channels is an accumulation of detached soil particles which have been transported by wind and water, and may contain a variety of contaminants. In coastal areas, some of the most severe long-term impacts from dredging are caused by the physical changes in

estuaries due to new work dredging. Maintenance dredging and dredged material disposal pose less severe threats, except where the sediments contain high levels of contaminants. Most research on river dredging was conducted in the upper Mississippi River and may only be partially applicable to other river systems. Impacts to the water column are generally slight. The alteration of river through new channel construction or deepening projects has severe direct and indirect impacts on the entire river and floodplain ecosystem. Long-term impacts include changes in hydrology and stream gradient that impact the river, swamps, backwaters, and the entire floodplain. (Moore-SRC)
W82-01768

SOME ENVIRONMENTAL AND SOCIAL IMPACTS OF THE JAMES BAY HYDROELECTRIC PROJECT, CANADA,
Brock Univ., St. Catharines (Ontario). Inst. of Urban and Environmental Studies.
F. Berkes.
Journal of Environmental Management, Vol 12, No 2, p 157-172, March, 1981. 3 Fig, 1 Tab, 14 Ref.

Descriptors: *Environmental effects, *Hydroelectric plants, *Subarctic zone, *James Bay, Canada, Social impact, Fisheries, Land tenure.

The James Bay hydroelectric project, which consists of a series of dams affecting the watersheds of several rivers in northern Quebec, is the most ambitious energy project ever attempted in Canada. Construction of the project, located in subarctic Canada, began in 1972, shortly after the project was announced. However, environmental information needed to plan mitigation measures was not available until about 1975. This pattern appears to be characteristic of large-scale development projects in remote areas, where the time lags involved in obtaining detailed environmental data are so lengthy that engineering plans proceed, for economic reasons, without the benefit of this environmental data as planning input. None of the 1975 recommendations for environmental protection measures with respect to the estuarine subsystem were adopted by the project. An environmental impact case study of the effects of the LaGrande Complex phase of the James Bay development examines the estuarine fisheries subsystem and the effects on this subsystem of changes in the flow regime of the LaGrande River, the relocation of the first dam on the LaGrande, saltwater encroachment up the river during the filling of the second dam, and the changes in the thermal regime of the river. A social impact case study discusses the effects of the road network associated with the hydroelectric project on the land tenure system of the native Cree Indians of the area. These analyses show that it is not easy for large projects in frontier areas to accommodate environmental considerations, since the lead times are too great and too little is known about the environment when the engineering decisions are being made. In addition, it is often impossible to assess the impacts of these projects after the fact due to the absence of baseline data and to the existence of a cumulative effect of relatively insignificant incremental impacts. (Carroll-FRC)
W82-01908

TRACING FOOD WEBS WITH STABLE HYDROGEN ISOTOPES,
Carnegie Institution of Washington, DC. Geophysical Lab.
M. F. Estep, and H. Dabrowski.
Science, Vol 209, No 4464, p 1537-1538, September, 1980. 1 Fig, 6 Ref.

Descriptors: *Food chains, Algae, Snails, Hydrogen, Mice, Mollusks, Chemical properties, Isotopic tracers, Boothbay harbor, Maine, Marine environment, Tidal pools, Metabolism, *Ecosystems, *Biological samples, *Biochemistry, Ecology, Food chains.

The relationship between the organically bonded hydrogen isotopic content of an animal and its food source was investigated using laboratory mice. Also investigated was the relationship between a simple, natural population consisting of snails and their possible algal food sources. The study concluded that the hydrogen isotopic content of the animal's food and not its water determine the animal's hydrogen isotopic content. Liver and muscle tissue from mice reared on a diet with a specific ratio of deuterium to hydrogen (D/H) had the same D/H ratio as in the food, not in the water. Northern Atlantic intertidal snails that feed almost exclusively on the brown alga Fucus vesiculosus have the same D/H ratio as Fucus vesiculosus and not that of the other algae made available to the snails. (Baker-FRC)
W82-02021

ENVIRONMENTAL STUDIES: THEIR IMPLICATIONS AND THE SPECIAL CASE OF EGYPT,
J. Rzoska.
Water Supply and Management, Vol 4, No 1/2, p 21-24, 1980. 2 Ref.

Descriptors: *Technical societies, *Environmental effects, Publications, Information exchange, Limnology, *Lake Nasser, *Egypt, Egyptian Society of Environmental Science, History, *Nile river, Social aspects, Economic aspects.

Integration of scientific disciplines in environmental studies is necessary, as illustrated by the efforts of the Egyptian Society of Environmental Sciences. The cultivable and inhabited land in Egypt is confined to the Nile River valley and is a product of the river. Desirable aims of water resources research in Egypt include studies of the historical succession of the land and its waters as well as the recent changes caused by the Aswan High Dam. Integrated historical and current studies are needed on Lake Qarun, the Wadi Natrun, and the delta lakes. Egypt's environmental problems are narrower in scope than in most countries, being confined to Lake Nasser, the Nile River, and its valley. Some suggestions for future consideration are a monograph on Lake Nasser (extending to old terraces, sediments, and ancient written records), and studies of the Wadi Natrun, the delta lakes, and fisheries. The Society should have a governing board of prominent scientists, a library of books on environmental subjects, information dissemination, and facilities for large and small workshops. (Cassar-FRC)
W82-02062

7. RESOURCES DATA

7A. Network Design

THE USE OF SPECIFIC CONDUCTANCE IN STUDIES OF NATURAL WATERS AND SOIL SOLUTIONS,
Lanchester Polytechnic, Conventry (England). Dept. of Geography.
I. D. L. Foster, I. C. Grieve, and A. D. Christmas.
Hydrological Sciences Bulletin, Vol 26, No 3, p 257-269, September, 1981. 4 Fig, 4 Tab, 27 Ref.

Descriptors: *Natural waters, *Specific conductivity, Water, Conductivity, Soil solution, Mineral water, *Dissolved solids, Suspended solids, Iron, Aluminum, Manganese.

In the absence of non-ionized material and above a pH of around 5.5, specific conductance has been considered a useful measure of total dissolved solids (TDS) for routine water quality analysis. Regression relationships may be used to explain high proportions of variance in TDS loads. In the study presented herein, the levels of dissolved organic matter in stream water and in throughfall were too low and displayed too little variability to be of significance in affecting the specific conductance (SC)/TDS relationship. Water samples for chemical analysis were obtained from two areas. First, river water samples were collected at a small cultivated basin in East Devon from the main stream and three sub-basins: a tile drain, drainage ditch and a woodland stream unaffected by cultivation. Second, water samples were collected from a variety of locations in a forested basin in North Warwickshire. Weekly samples were taken from the main stream and from throughfall beneath the tree canopy during 1978 and 1979. The soil water samples taken did have sufficient variation in dissolved organic matter (DOM) to influence the regression relationship, and DOM must be considered in estimating the dissolved load carried in soil solutions. It may also be of significance in streams draining moorland catchments. Attempts to calculate SC from consideration of the properties of simple solutions were relatively unsuccessful, although improvements in the McNeal model were achieved by including pH in a partial correlation data. Further improvements resulted from consideration of the effects of iron, aluminum, and manganese, whose solubility at low pH is greatly enhanced. (Baker-FRC)
W82-01646

METHODS OF STUDYING INVERTEBRATE DRIFT IN RIVERS,
Akademiya Nauk SSSR, Petrozavodsk. Karelskii Filial.
Yu. A. Shustov, and V. A. Shirokov.
Hydrobiological Journal, Vol 16, No 3, p 66-68, 1980. 1 Fig, 2 Tab, 7 Ref.

Descriptors: *Rivers, *Invertebrates, *Drift, Sampling, Sample preparation, Water sampling, Biological samples, Chrionomidae, Simuliidae, Ephemeroptera, Trichoptera, *Aquatic drift, *USSR.

In an attempt to study invertebrate drift in rivers, a trap was set in a river for a specified period of time, and the material obtained fixed with 4% formalin and processed in the laboratory. The drift sample contains benthic invertebrates, zooplankton organisms, winged and land insects, fish larvae, filamentous algae, scraps of aquatic vegetation, fallen leaves from trees and other debris. Trap exposure time is usually between a few minutes and a few hours to obtain material for a drift sample. Exposure time must be clearly identified in the study, however. Drift samples were taken on one of the bars of the Lizhma, a salmon river in the basin of Lake Onega, in August of 1978 for exposure times of 0.5, 1, 2, 4, and 8 hr. Samples were taken only during daylight, not before 8 a.m. nor after 8 p.m. The river reach sampled was a bar, where depth of 0.5 meters and flow rate of 0.3 meters/second were uniform over the whole width of the river, 15 meters. The results show that sampling times of .5 hours and 1 hour are to be preferred from the whole range of times investigated when taking drift samples under similar conditions. In order to study invertebrate drift in rivers under conditions differing from these, the optimum exposure time should be determined by similar methods. There were appreciable fluctuations in the abundance of the invertebrate drift in this study. The distribution density of benthic invertebrates and the level of drift in the river were not solely determined by the main environmental factors, but were also conditioned by a number of local conditions, the extent of the development of fouling on the stones, or the amount of organic detritus in the bottom material. (Baker-FRC)
W82-02074

WHERE DO WE GO FROM HERE.
R. Briggs.
Water, No 40, p 19-21, September, 1981. 1 Tab, 6 Ref.

Descriptors: *Automation, *Data acquisition, *Data collections, *Monitoring, *Data transmission, Computers, Hydrologic data collection, Water quality management, Water quality control, Sensors, Water treatment, Wastewater treatment.

A report issued by the National Water Council/Department of the Environment Working Party on Control Systems contains guidelines to clarify the water industry's needs for instrumentation, control, and automation (ICA) in water and wastewater treatment technology. To help implement these recommendations, representatives of the environment, industry and engineering factions were incorporated as consultants in the design stages of ICA improvements. Accurate data is required at each level of the management hierarchy in order for water industry management to be effective. Monitoring devices may be used to check the

quality of effluents and protect downstream receiving waters. A number of factors are listed which have contributed to the United Kingdom's dissatisfaction with the overall precision obtained from ICA equipment in the water industry in recent years. In transferring information about water quality to the final user, the weakest unit in the chain is usually the sensor. New advances to improve sensors used in water quality monitoring include the use of computer control and multifunctional sensor devices. (Geiger-FRC)
W82-02086

7B. Data Acquisition

ELECTRONIC MEASUREMENT AND RECORDING OF EVAPORATION LOSS,
J. A. Drabbe.
Water SA, Vol 7, No 3, p 150-154, July, 1981. 6 Fig.

Descriptors: *Evaporation, *Water storage, *Measuring instruments, Storage tanks, Drinking water, Surface tension, Rainfall.

A new electronic system for the measurement of evaporation loss in water storage tanks is described, which includes the recording of the data on a weekly or monthly chart. As the water level falls due to evaporation, a sensitive probe in the still-well switches on the supply of water to a flowmeter. This measures and delivers calibrated quantities directly to the still-well, where the rising water touches the probe and switches off the control circuit. Surface tension is used to provide a quick break of contact when the water surface suddenly falls away. The probe is constructed primarily of platinum, and the flow meter consists of two plastic bottles filled alternately with a sliding valve operated by 12 V solenoids. To counter the effects of rain, a small probe opens a small solenoid-operated drain cock to allow incoming rain to flow to waste. To date, results with the new method have been very encouraging. This method provides continuous readings rather than the required daily readings. (Small-FRC)
W82-01602

SOIL MOISTURE UPDATING AND MICROWAVE REMOTE SENSING FOR HYDROLOGICAL SIMULATION,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
For primary bibliographic entry see Field 2G.
W82-01611

REMOTE SENSING IN DEVELOPMENT,
Agency for International Development, Washington, DC.
C. K. Paul, and A. C. Mascarenhas.
Science, Vol 214, No 4517, p 139-145, October 9, 1981. 3 Fig, 9 Ref.

Descriptors: *Remote sensing, *Developing countries, *Satellite technology, *Water resources development, Exploration, Land use.

Among the uses of remote sensing in developing countries is subsurface water location. Satellite images of Bangladesh have located flooded and dry regions and indicated the vigor of vegetation (rice) between the wet and dry seasons. Understanding the changing flood patterns along rivers allows proper designation of land use. Landsat imagery in the Rukwa region, Tanzania, showed that Lake Rukwa was one body of water rather than two separate bodies as depicted on available maps, and that 5% of lakeshore land supposedly suitable for agriculture was actually under water. One problem with interpretation of satellite imagery to locate specific water resources is the technical expertise and computer equipment required, but often not available, in this part of the world. (Cassar-FRC)
W82-01719

AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, TAYLOR CREEK, FLA., AND LITLE RIVER, GA., 1979 DATA REPORT,
Science and Education Administration, Beltsville, MD. Hydrology Lab.
T. J. Jackson, T. J. Schmugge, L. H. Allen, Jr., P. O'Neill, and R. Slack.
Agricultural Research Results ARR-NE-13, September 1981. 38 p, 8 Fig, 11 Tab, 16 Ref, 1 Append.

Descriptors: *Remote sensing, *Aerial photography, *Soil water, Humid areas, Hydrologica data, Monitoring, Infrared imagery, Sensors, Georgia, Florida.

As part of a project to evaluate remote sensing in hydrologic studies, with primary emphasis on soil moisture measurements, in a wide range of physiographic and climatic areas, data were collected in late 1978 and during 1979 in two humid areas: Taylor Creek, Florida, and Little River, Georgia. Experiments were designed to collect remote sensing data concurrent with ground observations of hydrologically significant parameters and phenomena, primarily soil moisture within several surface layers. The observations were made on intensively monitored watersheds. The sampling locations in Florida were all in or west of the Taylor Creek Watershed. One flightline covered mostly citrus grove sites and the other traversed mostly pasture and swampy areas. All sampling locations in Georgia were within the Little River Experimental Watershed. The land cover has about 33% in crops, 40% in woodlands, and 8% in urban categories. The NASA 929 (C-130B) aircraft was the sensor platform used in these experiments. The sensor configuration included color infrared photography, a modular multispectral scanner, a thermal infrared radiometer, C and L band radiometers, a passive microwave scanner, and four active microwave sensors: K, C, L, and P band scatterometers. (Moore-SRC)
W82-01771

EFFECT OF THE ALGAL LENGTH/APERTURE LENGTH RATIO ON COULTER ANALYSES OF LAKE SESTON,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
H. A. Vanderploeg.
Canadian Journal of Fisheries and Aquatic Sciences, Vol 38, No 8, p 912-916, August, 1981. 2 Fig, 1 Tab, 28 Ref.

Descriptors: *Algae, *Particle size, *Seston, Lakes, Aquatic life, Phytoplankton, *Lake Michigan, Particle shape, Coutler Counter, Organic matter.

The accuracy of sizing long, thin algae in Lake Michigan water was improved by a more suitable combination of aperture tubes in the Coutler Counter method. Both seston and nylon fibers 200 and 500 micrometers long were sized in aperture tubes of different sizes. There was poor count overlap in some size ranges. This was caused by particles whose length was greater than the aperture length. The suggested technique uses the observations that the large aperture tubes more correctly size the longer particles and that count overlap is usually best in the smallest size categories. The largest tube selected must have an aperture length greater than the length of the longest algae. The size difference between apertures is affected by the shape of the seston. Although excellent count overlap was obtained with 50 and 400 micrometer aperture tubes for mixtures of microspheres similar to the lake seston, it was necessary to add a 140 or 200 micrometer tube for seston mixtures containing long, thin algae. (Cassar-FRC)
W82-01823

POWER SPECTRAL ANALYSIS OF A FORCE-MAIN FAILURE CAUSED BY WATERHAMMER,
McMaster Univ., Hamilton (Ontario). Dept. of Civil Engineering and Engineering Mechanics.
W. James, R. R. Hennessy, and J. W. Disher.
Canadian Journal of Civil Engineering, Vol 7, No 1, p 36-44, 1980. 5 Fig, 6 Ref.

Descriptors: *Water hammer, *Pipe failure, *Water pressure, Pipelines, *Main sewers, Leakage, Remote sensing, Spectral analysis, Monitoring, Water loss.

Leakage problems in a 14 inch asbestos cement sewage forcemain, 3963 ft long, in Ancaster, Ontario, prompted installation of pressure recording equipment on September 9, 1976. Between this date, and September 14, when a pipe failure occurred, 18 pressure recordings were made. This produced a complete record of water hammer pressure waves during deterioration and failure. Power spectral analysis pinpointed the initial small break, which was not detectable on the surface until several days later. After the initial crack appeared, the waterhammer wave changed dramatically. A noticeable frequency shift in the rigid column wave occurred shortly before the ultimate failure, which was caused by an apparent merging of the primary waterhammer wave with an existing and gradually increasing lower frequency wave. Air pockets increasing in size with deterioration produced short-duration, high pressures. Superposition of the two waves produced enough energy to rupture the already damaged pipes. This method may be useful in monitoring the condition of long pipelines. (Cassar-FRC)
W82-01826

DISCHARGE MEASUREMENTS BY A NEW-FORMED RELATIVE SALT-DILUTION METHOD IN SMALL TURBULENT STREAMS,
Norges Landbrukshoegskole, Vollebekk.
L. Bjerve, and O. Groterud.
Nordic Hydrology, Vol 11, No 3/4, p 121-132, 1980. 4 Fig, 2 Tab, 10 Ref.

Descriptors: *Discharge measurement, *Stream discharge, *Conductivity, Salt dilution method, Turbulent flow, Saline solution injection, Tracking techniques.

A new salt dilution method for determining water discharge in small turbulent streams relies on injection of concentrated salt solution at constant feed and measuring the dilution level downstream by in situ conductivity readings. Three injection apparatuses are described: a 7 liter chicken feeding bucket for 100 liters per sec discharge, a float-chamber apparatus for larger volumes and discharge up to 300 liters per sec, and a vacuum chamber apparatus for large water discharges. This constant injection method is compared with several other methods (sudden injection, V-notch weir, collection, and Harlacher) and found comparable. For the turbulent streams the new method was easier and more reliable. (Cassar-FRC)
W82-01891

THE APPLICATION OF RADIOACTIVE TRACERS FOR DETERMINATION OF BED-LOAD TRANSPORT IN ALLUVIAL RIVERS,
Copenhagen Univ. (Denmark). Dept. of Geography.
For primary bibliographic entry see Field 2J.
W82-01893

A SIMPLE DEVICE FOR QUANTITATIVE PSEUDOPERIPHYTON SAMPLING,
Lyon-1 Univ., Villeurbanne (France). Dept. de Biologie Animaux et Zoologie.
C. Amoros.
Hydrobiologia, Vol 68, No 3, p 243-246, February 16, 1980. 2 Fig, 1 Tab, 6 Ref.

Descriptors: *Water sampling, *Invertebrates, *Sampling, Cladocerans, Copepods, Bottom sediments, *Ponds, Aquatic plants, Littoral zone.

A simple device for sampling small invertebrates living among aquatic macrophytes in a pond is described. The device consists of a methyl methacrylate tube 1.2 meters high and 50 mm inside diameter, open at both ends and fitted with a sharp iron part at the bottom. It is operated by quickly pushing the bottom of the tube into the pond sediments deep enough to obtain a core to serve as a bottom stopper when the device is raised from the water. After inserting a rubber stopper in the

top, the captured animals and water are released through emptying holes in the side of the tube onto a filter form counting and identification. Sampling of cladocerans and copepods at two sites in the littoral zone of a fishpond produced good correlation within each station, but not between the two stations, using three replicate samples. (Cassar-FRC)
W82-01894

THE USE OF REMOTE SENSING FOR AN INTEGRATED INVENTORY OF A SEMI-ARID AREA,
Arizona Univ., Tucson. Office of Arid Lands Studies.
D. A. Mouat, J. B. Bale, K. E. Foster, and B. D. Treadwell.
Journal of Arid Environments, Vol 4, No 2, p 169-179, June, 1981. 4 Fig, 20 Ref.

Descriptors: *Semiarid lands, *Remote sensing, *Mapping, Arid lands, *Satellite technology, Pima County, Arizona, Vegetation, Geology, Water resources development, Water resources management, Soil types, Land use, Photography, Resources development, Resources management.

The Pima County, Arizona, Resources Inventory provides maps of land use and selected natural resources for a 23,000 sq km semiarid area. Satellite photography and other imagery supplied information on land use, natural vegetation distribution, land forms, and soil types. Field work supplied data on soil types from previously mapped areas, surficial geology, and slope angle. The maps produced by this project are usable for many purposes, including water resources management and development. Begun in 1976, the total costs for the inventory project were $72,000 or $3.00 per sq km. The method is applicable to any large arid or semiarid region. (Cassar-FRC)
W82-01910

MEASUREMENT OF IRRIGATED ACREAGE IN WESTERN KANSAS FROM LANDSAT IMAGES,
Kansas State Geological Survey, Lawrence.
K. M. Keene, and C. D. Conley.
Environmental Geology, Vol 3, No 2, p 107-116, 1980. 5 Fig, 3 Tab, 22 Ref.

Descriptors: *Remote sensing, *Satellite technology, *Irrigation, *Kansas, Agriculture, Infrared imagery, Landsat.

Video image analysis permitted rapid measurement of irrigated summer crops in western Kansas. Spectral response on LANDSAT MSS band 5 (visible red, 0.6-0.7 micrometers) images produces a low response from irrigated summer crops and high response from harvested and fallow fields and most soil types. This permits measurement of irrigated acreage at the rate of 1 hour per county, about 876 sq mi. Standard 1:1,000,000 LANDSAT positive transparency images are used for interpretation. This is a significant time savings compared with the 6 weeks required to analyze LANDSAT data describing a 3140 sq mi area using the false color composite image method. The video image analysis is prone to error when there is significant vegetation growth along streams or other water bodies and when ponds and reservoirs are present. In western Kansas neither of these conditions interferes with analysis. If necessary, the area of significantly large water bodies may be substracted from the irrigated acreage. (Cassar-FRC)
W82-01939

DEVICE FOR COLLECTING REPLICATE ARTIFICIAL SUBSTRATE SAMPLES OF BENTHIC INVERTEBRATES IN LARGE RIVERS,
Institute of Paper Chemistry, Appleton, WI.
D. R. Wefring, and J. C. Teed.
Progressive Fish Culturist, Vol 42, No 1, p 26-28, January, 1980. 2 Fig, 1 Tab, 4 Ref.

Descriptors: *Sampling, *Mechanical equipment, *Rivers, Costs, Design criteria, *Benthic fauna, *Invertebrates.

A device was designed for use in large rivers for suspending triplicate modified multi-plate samplers. Ease of construction and transportation and flexibility of use were important considerations, along with low cost and durability. The device consists of two zinc-plated mending plates bolted together and suspended from an expanded polyethylene boat fender with plastic-coated aircraft cable. Materials for the unit, excluding samplers, cost about $7.00. A field study indicated that the sampling unit provides an unbiased and inexpensive means of positioning triplicate modified multiplate samplers in large rivers. The unit also accommodates Periphytometer II samplers for monitoring periphyton communities. (Small-FRC)
W82-01947

A TEST UTILIZING SEDIMENT TRAPS, SURVEY RODS, AND RADIOGRAPHS TO MONITOR SEDIMENT ACCUMULATION FROM A DREDGING DISPOSAL OPERATION,
NALCO Environmental Sciences, Northbrook, IL.
G. R. Alther, and R. K. Wyeth.
Environmental Geology, Vol 3, No 2, p 97-105, 1980. 8 Fig, 5 Ref.

Descriptors: *Dredging, *Sediment discharge, *Measuring instruments, *Spoil disposal, Sediment distribution, Sediment traps, Survey rods, Radiographs, *Lake Erie, Fate of pollutants.

A combination of sediment traps, survey rods, and radiographs reduced errors in measuring the dispersal of dredged material (fine sand and coarse silt) in Lake Erie near Ashtabula, Ohio. The site was sampled before dumping began and four times after dredge material disposal during 1976. Dredge records indicate that about 24.1 million kg of sediment was discharged. The usual uncertainties with records of this type can be 45-65%. Errors in acoustic methods are 40-70%. The survey rod method accounted for 18,000 cu meters or 16.7 million kg (70%) of the material discharged, and the sediment traps, 14,000 cu meters or 12.5 million kg. Radiographs of sediment cores detected differences between the original and newly-deposited sediments. At the center of the disposal site 18 cm of sediment had accumulated the first day of disposal, May 24. The flat, cone-shaped pile increased to 28 cm after 3 days and to 36 cm after 1 week. (Cassar-FRC)
W82-01950

PHOTOMETRIC INVESTIGATIONS OF PRECIPITABLE WATER AND OPTICAL DEPTH WAVELENGTH EXPONENTS IN AN URBAN AREA,
Wyoming Univ., Laramie. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 2B.
W82-01966

OBSERVATIONS OF TWO COLORADO THUNDERSTORMS BY MEANS OF A ZENITH-POINTING DOPPLER RADAR,
Arizona Univ., Tucson. Inst. of Atmospheric Physics.
For primary bibliographic entry see Field 2B.
W82-01967

APPLICATIONS OF AERIAL PHOTOGRAPHY,
T. Gass.
Water Well Journal, Vol 35, No 8, p 38-39, August, 1981. 1 Fig.

Descriptors: *Groundwater, *Remote sensing, Aerial photography, Water supplies, Water resources development, Groundwater budget.

Applications of aerial photography and technology for the possible improvement of evaluating groundwater resources are considered. Recent advances in remote sensing technology have enhanced the ability to evaluate local and regional hydrogeological conditions. Aerial photography provides two basic types of clues for evaluating groundwater resources. Direct indicators refer to the detection of physical characteristics of the ground directly associated with groundwater. These would include the identification of springs, seeps and discharges of groundwater into surface water bodies. Indirect indicators are clues which enable assumptions or inferences to be made about groundwater resources. Some of these indirect indicators provide information for defining groundwater availability and changes in groundwater conditions. Various techniques of remote sensing are available. Black and white and color photography can give evidence of surface water-groundwater interfaces, soil moisture and some types of vegetation, along with delineation of structural geology, rock type, soil type, vegetation patterns and drainage characteristics. Thermal infrared imagery can detect soil moisture, soil types, zones of groundwater discharge and changes in rock type. One very successful application has been in detecting groundwater discharging to bodies of open water. Side looking airborne radar (SLAR) can detect soil changes and lineaments, distinguish between coarse- and fine-grained surface materials, and delineate zones of recharge. The monopulse radar system is relatively new and offers the ability to penetrate soil depth of 10 meters or to the top of the table if it is less than 35 feet beneath the surface. (Baker-FRC)
W82-01988

MATHEMATICAL MODELING OF STREAM WATER QUALITY BY A NEW MOMENT METHOD: FIELD INVESTIGATION OF A TIDAL RIVER,
National Cheng Kung Univ., Tainan (Taiwan). Dept. of Environmental Engineering.
C-G. Wen, J-F. Kao, and L. K. Wang.
Journal of Environmental Management, Vol 12, No 2, p 127-140, March, 1981. 4 Fig, 5 Tab, 7 Ref.

Descriptors: *Mathematical models, *Water quality, *Tidal rivers, Streams, Pollution load, Biological oxygen demand, Dissolved oxygen, Oxygen demand, Water pollution control, Tam-Sui River, *Taiwan, Path of pollutants.

A new moment method has been developed which can be used to systematically identify water quality parameters for both tidal and non-tidal streams. Results of a field study conducted on the Tam-Sui River in Taiwan, Republic of China, are used to demonstrate the use of this method to identify the following water quality parameters: (1) the reaeration coefficient; (2) the coefficient of organic settling and other parameters; (3) the rate of organic addition to the overlying water from the bottom deposits as well as local run-off; (4) the oxygen production rate of photosynthesis; and (5) the longitudinal dispersion coefficient. The following information must be known in order to use this method: the stream velocity, the downstream distance, the stream water temperature, the biochemical oxygen demand of stream water at each sampling station, the dissolved oxygen of stream water at each sampling station, and the biochemical oxygen demand reaction rate. A chi-square test was conducted to evaluate the correctness of the biochemical oxygen demand model and the dissolved oxygen deficit model developed for the Tam-Sui River. This analysis showed that the proposed moment method can effectively estimate the characteristic parameters of steady state stream models. Observed biochemical oxygen demand and dissolved oxygen values from sampling stations on the Tam-Sui River were in excellent agreement with those estimated by the mathematical models. Once the biochemical oxygen demand model and the dissolved oxygen models have been developed for a stream, the biochemical oxygen demand and dissolved oxygen deficit at any downstream distance X can be readily calculated, and the degree of stream pollution can be assessed. (Carroll-FRC)
W82-01995

SCREENED AUGER AIDS INVESTIGATION,
Johnson Co., Haslett, MI.
D. M. Baron.
Johnson Driller's Journal, Vol 53, No 1, p 4-5, 1981.

Descriptors: *Drilling equipment, *Augers, Well screens, Wells, Test wells, *Groundwater pollution, *Chemical wastes, Muskegon, Michigan.

A new screened auger facilitated drilling on an investigation of groundwater contamination at an abandoned chemical plant dump near Muskegon, Michigan. The later modification of the apparatus consisted of a 2-ft long well screen with an 18 inch stainless steel flush tubing on each end, to which was welded the continuous auger flighting and the top and bottom ends of the hollow stem auger. It eliminates the problem of sand-lock inside hollow stem augers. The 3 and 1/4 inch inside diameter auger can also accept a submersible pump for efficient water extraction and downhole geophysical tools. (Cassar-FRC)
W82-02096

7C. Evaluation, Processing and Publication

HYDROLOGIC DATA FOR EXPERIMENTAL AGRICULTURAL WATERSHEDS IN THE UNITED STATES, 1972,
Science and Education Administration, Beltsville, MD. Water Data Lab.
For primary bibliographic entry see Field 2A.
W82-01772

SELECTED DRILL-STEM-TEST DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from the OFSS,USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $4.75 in paper copy, $4.00 in microfiche. Geological Survey Open-File Report 81-326, (WRI), April, 1981. 20 p, 1 Fig, 1 Plate, 1 Tab, 3 Ref.

Descriptors: *Data collections, *Groundwater, *Aquifers, *Test wells, Potentiometric level, Oil wells, Transmissivity, Maps, Sites, *Montana, Northern Great Plains, Drill-stem tests.

Selected drill-stem-test data were collected for use in the hydrologic analysis of aquifers in the northern Great Plains area of Montana. To supplement existing data defining the potentiometric surface of various aquifers, shut-in pressures recorded during drill-stem tests of oil and gas test wells were used to calculate the altitude of the potentiometric surface. The transmissivity of the aquifers also was calculated if sufficient data existed. Records for 627 drill-stem tests from 523 wells are tabulated in this report. Data include well location, well name, formation tested, well epth, tested interval, date tested, test number, flow period, transmissivity, shut-in pressure, and altitude of water surface. Locations of the wells are shown on a map at a scale of 1:1,000,000. (USGS)
W82-01774

SURFICIAL GEOLOGY OF DUGWAY QUADRANGLE, OSWEGO COUNTY, NEW YORK,
Geological Survey, Albany, NY. Water Resources Div.
T. S. Miller.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $2.50 in paper copy, $0.50 in microfiche. Geological Survey Open-File Report 81-335 (WRI), 1981. 1 Sheet.

Descriptors: *Geology, *Glacial aquifers, *Groundwater potential, *Natural resources, Geohydrology, Wells, Water yield, Maps, *New York, Oswego County, Dugway quadrangle.

The location and extent of 11 kinds of surficial deposits in Dugway quadrangle, Oswego County, N.Y., are mapped on a 7.5-minute U.S. Geological Survey topographic map. The map was compiled to indicate the tithology and potential for groundwater development at any specific loaction. (USGS)
W82-01775

SELECTED HYDROGEOLOGIC DATA FROM THE NORTHERN GREAT PLAINS AREA OF MONTANA,
Geological Survey, Helena, MT. Water Resources Div.
G. W. Levings.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $8.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-534, August, 1981. 241 p, 1 Fig, 1 Plate, 1 Tab, 3 Ref.

Descriptors: *Groundwater, *Data collections, *Aquifer characteristics, *Well data, Wells, Springs, Sites, Water use, Water level, Groundwater movement, Specific capacity, Specific conductivity, Water temperature, Aquifers, Transmissivity, Storage coefficient, *Montana, Northern Great Plains, *Hydrologic maps.

Selected hydrologic data have been used in a 4-year study of aquifers of Cenozoic and Mesozoic age in the northern Great Plains to define the hydrologic system and to generate hydrologic maps. Records of 6,754 wells and 188 springs are tabulated in the report. The well data include site location, county, date completed, depth of well, casing diameter, type of lift, use of water, principal aquifer, altitude of land surface, water level, discharge, specific capacity, specific conductance, and water temperature. The spring data include site location, county, use of water, principal aquifer, altitude of land surface, type of spring, discharge, date discharge measured, specific conductance, and water temperature. Locations of the wells and springs are shown on a map at a scale of 1:1,000,000. (USGS)
W82-01777

LOW-FLOW FREQUENCY AND FLOW DURATION OF TENNESSEE STREAMS,
Geological Survey, Nashville, TN. Water Resources Div.
For primary bibliographic entry see Field 2E.
W82-01779

WATER-RESOURCES INVESTIGATIONS OF THE U.S. GEOLOGICAL SURVEY IN MONTANA, OCTOBER 1980 THROUGH SEPTEMBER 1981,
Geological Survey, Helena, MT. Water Resources Div.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price $6.50 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-817, July, 1981. 46 p, 3 Fig, 2 Tab.

Descriptors: *Data collections, *Sites, *Hydrologic data, Water quality, Surface water, Groundwater, Available water, *Montana.

The report describes the investigative efforts of the U.S. Geological Survey toward the water resources of Montana. Hydrologic information and knowledge of the water resources are gained and disseminated principally by programs of (1) collecting hydrologic data on a continuing basis, (2) conducting water-resources appraisals of surface and ground water, (3) conducting supportive research in hydrology and related fields, (4) disseminating water data and results of investigations to the public, (5) coordinating acquisition of water data by Federal agencies, and (6) providing technical assistance in hydrologic fields to other government agencies. (USGS)
W82-01787

RECORDS OF WATER LEVELS IN UNCONSOLIDATED DEPOSITS IN EASTERN SOUTH DAKOTA,
Geological Survey, Huron, SD. Water Resources Div.
W. L. Bradford.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $31.75 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-924, June, 1981. 253 p, 4 Fig, 2 Tab.

Descriptors: *Water level, *Observation wells, *Awuifers, Sites, Water measurement, Monitoring, Well data, Hydrographs, *South Dakota, Minnehala County.

Water levels in unconsolidated deposits measured by the U.S. Geological Survey and State agencies throughout eastern South Dakota during the period 1948-1980 are presented in tabular and graphic form. (USGS)
W82-01788

QUALITY OF WATER AND TIME OF TRAVEL IN PART OF TILLATOBA CREEK BASIN, MISSISSIPPI, OCTOBER 1974 TO SEPTEMBER 1980,
Geological Survey, Jackson, MS. Water Resources Div.
G. A. Bednar.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver CO. 80225, Price: $12.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-825, 1981. 87 p, 23 Fig, 10 Tab, 10 Ref.

Descriptors: *Water quality, Surface water, *Streamflow, *Dye releases, Watershed management, Data collections, Suspended sediments, Discharge measurement, Nutrients, Biochemical oxygen demand, Bacteria, Gaging stations, Sites, Water analysis, *Path of pollutants, *Time of travel, *Mississippi, Tallahatchie County, Yalobusha County, Grenada County, *Tillatoba Creek basin.

A 6-year quality-of-water and time-of-travel study was conducted during the construction phase of a flood-water protection and flood prevention project in a 118 square mile area of Tillatoba Creek basin in northwest Mississippi. Weekly suspended sediment, daily discharge, time of travel, nutrient, biochemical oxygen demand, bacteria and field data were collected. The study was conducted by the U.S. Geological Survey in cooperation with the U.S. Soil Conservation Service. The results of the study are presented in graphs and tables without interpretation. (USGS)
W82-01791

SEDIMENT DATA FOR STREAMS NEAR MOUNT ST. HELENS, WASHINGTON--VOLUME 1, 1980 WATER-YEAR DATA,
Geological Survey, Tacoma, WA. Water Resources Div.
R. L. Dinehart, J. R. Ritter, and J. M. Knott.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, Price: $11.25 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-822, 1981. 82 p, 3 Fig, 3 Tab, 3 Ref.

Descriptors: *Fluvial sediments, Data collections, *Streams, *Sediment load, Monitoring, Sediment transport, Particle size, Sediment distribution, Sediment discharge, Sampling, Water temperature, Suspended sediments, *Volcanoes, *Washington, *Mount St. Helens, Toutle River basin, Cowlitz River basin.

This report presents fluvial sediment data collected primarily in response to the eruption of Mount St. Helens. To monitor the sediment transported by streams in the Mount St. Helens area and the particle-size distributions of the sediment, the Water Resources Division of the U.S. Geological Survey initially established 18 fluvial sediment stations. In this report, concentrations and discharges of suspended sediment are given for 16 fluvial-sediment stations (5 are in the Toutle River basin) and for 11 miscellaneous sampling sites. Also included are particle-size distributions of suspended sediment and bed material, water discharge, and water temperature for many of the sediment samples. Daily sediment discharges for the period May 18 to September 30 were calculated for Toutle River at Highway 99 near Castle Rock and Cowlitz River at Castel Rock. Over 150 million tons of sediment are estimated to have passed the Toutle River at Highway 99 station on May 18-19, 1980. High concentrations of suspended sediment persist-

ed at several stations throughout the spring and summer of 1980. (USGS)
W82-01792

8. ENGINEERING WORKS

8A. Structures

RECONSTRUCTION OF A SMALL DAM FOR A RECREATIONAL LAKE.
For primary bibliographic entry see Field 4D.
W82-01604

MOROCCO'S LARGEST MULTIPURPOSE SCHEME,
Ministere des Travaux Publics et des Communications, Rabat (Morocco). Direction de l'Hydraulique.
N. Dinia, and R. B. Bischof.
International Water Power and Dam Construction, Vol 33, No 7, p 19-25, July, 1981. 10 Fig, 4 Tab, 3 Ref.

Descriptors: *Dam construction, *Water supply development, Hydroelectric power, Irrigation, Rivers, *Morocco, Water resources development, Potable water.

Eighty percent of all state investments for agriculture in Morocco are concerned with irrigation projects. It is hoped that this policy will not only ensure adequate food supply for this country, which imports a considerable part of its basic food requirements, but also help to provide jobs and solve the severe problem of the rural exodus. In an average year 80% of the precipitation falls between November and April. The ratio between annual discharge in a typical dry year and the discharge in a typical wet year is as large as 1:6. Dry years often occur consecutively. One major project is the Al Massira multipurpose scheme, which is also the keystone of the Oum-er-R'bia development plan. The Al Massira dam is located halfway between the cities of Casablanca and Marrakesh on the lower reach of the Oum-er-R'bia river. The purpose of the plan is to supply drinking water for towns along the lower reach of the river, especially for the coastal region between Casablanca and Safi; to supply water to the phosphate industry; to extend the irrigated area in the Doukkala region from 40,000 to 100,000 ha; to supply peak energy at a yearly rate of 240 GWh; and to provide flood control. Specifics of dam construction discussed include selection of dam type, standard buttresses, grouting and drainage, foundation excavation, mass concrete, and monitoring arrangements. For the saddle dam construction used specific information is available concerning foundation, fill materials, spillways, hydrological data, bottom outlets, power intakes, and river diversion. (Baker-FRC)
W82-01724

EXPLOITING THE WATERS OF LAKE CHAD.
International Water Power and Dam Construction, Vol 33, No 8, p 15-16, August, 1981. 2 Fig, 1 Tab.

Descriptors: *Irrigation programs, *Canal construction, Seepage, Water supply, Water resources development, Resources development, Chad Basin, *Lake Chad, Lakes, *Africa, Nigeria.

An irrigation project drawing on the waters of one of the largest of Africa's lakes, Lake Chad, is described. The lake covers some 100,000 ha of flat clay plain in Bornu State, 120 km northeast of the state capital, Maiduguri. The lake is land-locked, with no outlet, and is fed mainly by the river Chari. The basic principle of the scheme is that water is drawn from Lake Chad through a 29 km intake channel to the main pumping station at Kirinowa. The main canal then runs for some 22 km to a diversion structure which provides a main canal to each of the three irrigated areas. The initial 9 km of the intake channel were first excavated by scrapers to half the final depth, when groundwater was found, and thereafter dredged. The remaining 20 km was dredged by floating cuttersuction dredgers. The main canal from Kirinowa station to the main diversion structure is 22 km long, and was a cut-and-fill construction with embankments; the bed was clay-lined to a minimum thickness of 1 meter. The project will have four main pumping stations. Hydrological studies show that lake levels during 1870-1970 have generally been higher than at present. Thus the droughts of the early 1970s are regarded as temporary aberrations, rather than as indicative of new low norms. Careful planning has ensured that the water balance in the lake can be maintained and the lake's variation in level can be kept to a reasonable minimum. (Baker-FRC)
W82-01726

CAPE TOWN WATERWORKS SERVICE RESERVOIRS: PLATTEKLOFF (1974) AND TYGERBERG (1964).
Civil Engineer in South Africa, Vol 22, No 1, p 19-21, January, 1980. 3 Fig.

Descriptors: *Reservoirs, *Water treatment, *Cape Town, South Africa, Water demand, Water resources development, Water supply.

The major purposes of normal gravity supply service reservoirs are to permit operation of filtration and pumping plant at substantially constant rates over given periods, usually of about a week, and to allow main pipeline capacity of less than the absolute peak demand rate; to maintain a more or less constant supply pressure as near as topography permits to the center of gravity of the area supplies by the reservoir, thus permitting optimum design of the distribution system and safeguarding this as well as private installations against excessive pressure; and to provide a supply in the event of short-term failure of or damage to conservation works, filtration works and pumping plants caused by normal and abnormal events. Two water supply projects are described which terminate in covered filtered water service reservoirs, the Wemmershoek and Voelvlei projects. It is difficult to forecast the optimum water levels for the various main reservoirs feeding a gravity supply. Storage depth is also difficult to determine objectively. Reservoirs with vertical walls of mass or reinforced concrete are usually cheapest, especially when surrounded by backfilling or embankment. The task of landscaping a service reservoir which is necessarily located above the level of most adjacent developments and is a landmark only to air travellers is easily done with planting of embankment slopes and grassing adjacent grounds. Brief mention is made of the construction costs. (Baker-FRC)
W82-01747

EVALUATING SCOUR AT CULVERT OUTLETS,
Colorado State Univ., Fort Collins. Engineering Research Center.
For primary bibliographic entry see Field 4D.
W82-01934

GROUT CURTAIN IN THE FOUNDATION OF THE ARCH DAM OF THE INGURI HYDROELECTRIC STATION,
E. V. Krylova, M. B. Remenyak, and G. G. Tuzhikhin.
Hydrotechnical Construction, No 10, p 991-996, October, 1980. 3 Fig, 2 Tab, 7 Ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No 10, p 4-7, October, 1980.

Descriptors: *Grouting, *Dam foundations, *Arch dams, Foundation rocks, Permeability, Karst, Absorption, Rock mechanics, *Inguri Dam, USSR, Hydroelectric plants, Carbonate rocks, Seepage control.

The installation of the 120 m deep grout curtain in the foundation of the Inguri hydroelectric plant dam, USSR, is described. Although simulations indicated that seepage losses would not exceed the permissible limits, a grout curtain was constructed for protecting the abutting bank masses from water encroachment and for reducing general seepage discharge. Zones with relatively high permeability were found in the right bank fault and the left bank ancient terraces. The curtain is double-row with 1.7 m between rows and was constructed in descending zones of 5 m. Control holes were tested in crucial regions. Absorption of grout varied between 20 and 4000 kg per m. The greatest grout absorption occurred on the left bank, where karstification was present. Before grouting, 3% of the rocks had a specific water absorption of less than 0.02 liters per min, and after grouting, 80% had less than 0.03 liters per min. Maximum values of specific water absorption decreased from 3 to 0.71 liters per min. As of January 1980 the curtain is operating effectively. Further treatment is planned for some large joints. (Cassar-FRC)
W82-01973

RECORDING UNDERGROUND,
Yorkshire Water Authority (England).
C. Humphries.
Water, No 34, p 33-34, September, 1980. 2 Fig.

Descriptors: *Sewers, *Water mains, *Maps, Sewer systems, Water conveyance, Pipelines, Metropolitan water management, Water management, Standards, Wastewater management, *Great Britain.

Adequate records of sewers and water mains are essential for the design, construction, reconstruction, maintenance, and operation of these water conveyance systems. The water industry in Great Britain has about 500,000 kilometers of sewers and water mains buried out of sight which are worth perhaps 50,000 million pounds sterling. Location records are needed to provide clear information on the position, size, level, materials, function, and age of the apparatus. Condition records are needed to provide information on the condition and operational history of the apparatus, including the results of inspections and surveys and a record of all maintenance and repair work. There is a need for more comprehensive statutory minimum requirements for records and for more standardization of record systems. Standard formats should be adopted for record maps and a standard referencing system should be implemented. Duplicate sets of records should be maintained in a secure location. The possibility of future computerization of records should be considered when revising record systems. The Standing Technical Committee on Sewers and Water Mains has also made several recommendations with respect to access to maps and records, public access to information, the inclusion of non-statutory information in public utilities records, and special arrangements for fundings and transfer of records. (Carroll-FRC)
W82-02036

SULBY RESERVOIR - PROVIDING WATER FOR THE ISLE OF MAN,
Hill (G.H.), Manchester (England).
P. G. Eccles.
Water Services, Vol 85, No 1023, p 233-235, May, 1981. 1 Fig.

Descriptors: *Rockfill dams, *Reservoir construction, *Reservoir stages, Reservoirs, Dam design, Long-term planning, Water resources development, *Isle of Man, Great Britain.

The construction of the Sulby reservoir includes construction of a dam designed to meet the Isle of Man's water needs for 25 years, followed by construction of a larger dam to meet more distant needs. The drawdown works, pumping station, and rising main are to be completed by spring 1981. The reservoir should be totally operational by the summer of 1982. The dam site is located along the Sulby river and is underlain by Manx slate. The outer shells of the dam are of rockfill obtained from the quarry within the reservoir basin. The original first stage dam is provided with a 750 mm thick central asphaltic concrete core designed to be extended later. After full development, the catchment area will be 1620 ha, with a reservoir capacity of 4540 liters. The water supply pipe has valved intakes at three levels, and water will be supplied by gravity to the filter plant at Sulby Village. Water is also supplied to a hydroelectric generating station below Block Eary. The reservoir is needed to meet the increasing summer demand of visitors to the island. (Small-FRC)
W82-02068

8C. Hydraulic Machinery

INTAKES AND OUTLETS FOR LOW-HEAD HYDROPOWER,
Bureau of Reclamation, Denver, CO. Engineering and Research Center.
C. A. Pugh.
Journal of the Hydraulics Division, Proceedings of the American Society of Civil Engineers, Vol 107, No HY9, p 1029-1045, September, 1981. 16 Fig, 27 Ref.

Descriptors: *Hydroelectric plants, *Intakes, *Outlets, *Design criteria, Hydraulic structures, Hydraulic machinery, Turbines, Hydraulic turbines, Reviews, Construction costs, Powerplants, Vortices, Piers, Trash racks, Fish passages, Flow discharge.

A state of the art survey on design practices for hydropower development in low-head (less than 20 meters) sites is based on the literature and on information from manufacturers and consultants in the field. With rising fossil fuel costs making the low-head sites more attractive economically, it is desirable to determine possible design changes to lower construction costs without producing significant head losses. Flow passages for low-head hydropower development cannot be standardized because of structural and geological differences and fish passages. However, where geological and structural considerations are similar, the same design may be used for a series of installations, reducing engineering and design costs. The possibility of shortening draft tubes (responsible for 30% of civil costs) using boundary layer control is explored. No research in this area has been done on hydraulic turbines. Intakes may probably be reduced in size or simplified in shape without losing efficiency because flow volumes are low. An example is the use of flat surfaces to approximate curved surfaces. Many hydraulic structures were designed with the demands of high flows and pressures experienced in high-head systems. Since low-head systems do not exert these severe demands, it is possible that equipment can be simplified. (Cassar-FRC)
W82-01979

8D. Soil Mechanics

PROBABILISTIC STABILITY ANALYSIS OF EARTH SLOPES,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
E. H. Vanmarcke.
Engineering Geology, Vol 16, No 1/2, p 29-50, July, 1980. 10 Fig, 21 Ref.

Descriptors: *Stability analysis, *Slope stability, *Probabilistic process, Soil stabilization, Mathematical studies, Slopes.

The basic three-dimensional stability problem of earth slopes is considered within a probabilistic framework for slopes under drained, undrained, or partially drained conditions. The methodology presented permits analysis for fairly general shapes of the failure surface by representing effects attributable to the end sections of the failure surface in a simplified manner. It is necessary to account for the three-dimensional nature of the problem in extending conventional stability analysis into the realm of probability. Estimates can be obtained for the probability that failure will occur anywhere along an embankment, which has important implications in the design of cuts and slopes. This method can be a cornerstone for the construction of a more complete methodology of slope reliability assessment which can incorporate time effects and uncertainties about loading and environmental conditions. (Small-FRC)
W82-01952

CURRENT METHODS OF DYNAMIC ANALYSIS FOR SEISMIC STABILITY OF EARTH DAMS,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
W. F. Marcuson, III, P. F. Hadala, and A. G. Franklin.
Engineering Geology, Vol 16, No 1/2, p 19-28, July, 1980. 2 Fig, 21 Ref.

Descriptors: *Dam stability, *Stability analysis, *Earth dams, Seismology, Earthquakes, Liquefaction, Engineering.

Two methods used by the U.S. Army Engineers Waterways Experiment Station to analyze the seismic stability of earth dams are outlined. Evaluation of the liquefaction potential of a dam includes a field investigation, routine laboratory tests, development of a soil profile, seepage analysis, static analysis, development of design earthquake, dynamic analysis, determination of available strength of material, comparison of shear strength and shear stress, and factor of safety. Permanent displacement analysis combines the sliding block analysis with the embankment response analysis. This analysis leads to an estimate of the amount of permanent displacement of the rigid mass. This method also includes laboratory tests, stability analysis, computation of displacement potential, and determination of tolerable displacement potential. These analyses provide insight so that the proper engineering judgment can be made. (Small-FRC)
W82-01953

THE ACCURACY OF EQUILIBRIUM METHODS OF SLOPE STABILITY ANALYSIS,
California Univ., Berkeley. Dept. of Civil Engineering.
J. M. Duncan, and S. G. Wright.
Engineering Geology, Vol 16, No 1/2, p 5-17, July, 1980. 2 Fig, 6 Tab, 12 Ref.

Descriptors: *Stability analysis, *Slope stability, *Equilibrium, Mathematical studies, Safety, Slopes, Soil stabilization.

Equilibrium methods of slope stability analysis are discussed including equations, unknowns, and assumptions, and the accuracy of the methods is evaluated. Inaccuracies can arise from the assumptions that are made and neglected conditions of equilibrium. The ordinary method of slices, force equilibrium procedures, and Bishop's modified method do not satisfy all of the conditions of equilibrium. Under some circumstances, these methods may be inaccurate. For example, the ordinary method of slices may give values of F (factor of safety) which are 50% smaller than the corrected value if used for effective stress analyses of slopes with high pore pressures. Methods which satisfy all conditions of equilibrium, including Janbu's, Spencer's, and Morgenstern and Price's methods have accuracies of + or - 5%. When these methods are used, the engineer is justified in considering the factors of safety he calculates to be correct in terms of the mechanics of the problem. (Small-FRC)
W82-01954

8E. Rock Mechanics and Geology

TECTONIC STATE: ITS SIGNIFICANCE AND CHARACTERIZATION IN THE ASSESSMENT OF SEISMIC EFFECTS ASSOCIATED WITH RESERVOIR IMPOUNDING,
Geological Survey, Menlo Park, CA.
R. O. Castle, M. M. Clark, A. Grantz, and J. C. Savage.
Engineering Geology, Vol 15, No 1/2, p 53-99, January, 1980. 9 Fig, 5 Tab, 133 Ref.

Descriptors: *Reservoir filling, *Seismicity, *Tectonics, Rock mechanics, Geologic faults, Seismology, Strain, Stress, Geologic fractures, Earthquakes, Deformation, Geologic history, *Reservoir design.

An assessment of seismicity associated with filling of large reservoirs should begin with an evaluation of the natural tectonic state. This will reveal whether the impoundment itself is the basic cause of seismicity, it is coincidental, or it is the result of a triggering effect, which is most likely. Deformational style is more critical in forecasting the occurrence of impoundment-induced seismicity than are existing fractures or accumulated elastic strain. Reservoir-associated seismicity is usually seen in areas combining steeply dipping faults, relatively high strain rates, and other extensional or horizontal-shear strains. Reservoir loading may modify the natural tectonic state, as do the following: underground explosions, fluid injection, fluid extraction, underground mining, and volcanic emissions. The possibility of seismic activity is enhanced by reservoir filling as a result of increased fluid pressures and surface loading, which increases the likelihood of crustal failure in areas of normal and transcurrent faulting and inhibits failure in areas of thrust faulting. A table summarizes data on 57 dams throughout the world, their vital statistics, geology, and tectonic activity. Of 33 reservoir sites where seismic activity has been documented, 10 are in seismic areas. (Cassar-FRC)
W82-01951

8G. Materials

HYDRAULIC TESTING OF PLASTIC FILTER FABRICS,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Y. H. Chen, D. B. Simons, and P. M. Demery.
Journal of the Irrigation and Drainage Division, Proceedings of the American Society of Civil Engineers, Vol 107, No IR3, p 307-324, September, 1981. 8 Fig, 2 Tab, 8 Ref.

Descriptors: *Plastics, *Fabrics, *Filters, *Hydraulic properties, *Erosion control, Filter media, Soil types, Bacteria, Permeability coefficient, Soil stabilization, Soil conservation, Soil water, Bank stabilization.

Plastic filter fabrics of the nonwoven type (mean opening size, 0.10-0.95 mm) were laboratory-tested in four types of fine soil (sand, loam, and two sandy loams) to document their hydraulic performances. These materials provide an inexpensive, durable, easy-to-install alternative to a graded filter system. They have been used in bank protection, subdrainage protection, beach protection, and erosion control at bridges. The hydraulic analysis of each fabric consisted of 6 phases: a water filtration discharge study, a water pressure analysis, an analysis of sediment discharge through the plastic filters, a soil size distribution analysis, an analysis of permeability changes, and a bacterial and fabric filter analysis. The presently used Corps of Engineers criteria were found too conservative. The following procedure is recommended for selecting a filter fabric: (1) determine the soil permeability coefficient and size distribution of soil layers to be protected, (2) apply given equation to determine whether or not the soil is a filter (natural graded soils usually are), and (3) select a fabric with a permeability coefficient equal to or larger than that of the soil, using one given equation if the soil layer is not a filter, and two given equations if the soil layer is a filter. Local clogging of the filter can be expected in the latter case under conditions of high discharge. (Cassar-FRC)
W82-01613

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

A PERSPECTIVE ON ESTUARINE AND COASTAL RESEARCH FUNDING,
Dartmouth Coll., Hanover, NH.
C. B. Officer, L. E. Cronin, R. B. Biggs, and J. H. Ryther.
Environmental Science and Technology, Vol 15, No 11, p 1282-1285, November, 1981. 3 Tab.

Descriptors: *Research facilities, *Estuaries, *Financing, *Publications, Research properties, Coastal waters, Administrative agencies, Environmental effects, Funding, Universities.

The academic community has produced 77% of the past 5 years' refereed research literature on estuaries, and federal, state, municipal, and industrial sources, the remainder. The most significant cause of this disproportionality is that scientists within the government laboratories are generally required to solve problems needing immediate attention, whereas academia performs more basic research. Academic institutions received 31-37% of total federal estuarine-related funds, depending on the source of the statistics. The National Science Foundation is given credit for more support (21%) than any single agency and has the lowest cost per publication. Most of the federal research facilities for marine environmental research have been established in the past 10 years, but academic research facilities have not been similarly expanded. The authors suggest that the academic community and federal agencies should cooperate in identifying and implementing research on a regional and national scale. (Cassar-FRC)
W82-01803

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

U.S. GEOLOGICAL SURVEY REPORTS ON THE WATER RESOURCES OF FLORIDA, 1886-1980, SECOND EDITION,
Geological Survey, Tallahassee, FL. Water Resources Div.
N. D. Hoy, J. D. Simmons, and M. Claiborne.
Available from the OFSS, USGS, Box 25425, Fed. Ctr., Denver, CO. 80225, $28.00 in paper copy, $3.50 in microfiche. Geological Survey Open-File Report 81-816, 1981. 212 p.

Descriptors: *Bibliographies, *Groundwater, *Surface water, Publications, Indexing, *Florida.

The U.S. Geological Survey has released a listing of its reports on water resources in Florida for the period 1886-1980. Most of the reports contained in the listing were prepared by the U.S. Geological Survey in cooperation with numerous public agencies in Florida. The compilation has a full bibliographic list of reports, arranged alphabetically by senior author. In addition, the reports are indexed by geographic areas and by subject. Only two lines are used for each entry in the indexed portions, the complete reference being given only in the bibliographic list. (USGS)
W82-01778

SUBJECT INDEX

3- (TRIFLUOROMETHYL)-4-NITROPHENOL
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

ACCUMULATION
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

ACID RAIN
Acid Precipitation,
W82-01607 5C

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

Acid Rain Agreement,
W82-01933 5B

Acid Rain and Environmental Policy,
W82-01987 5B

Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

ACIDIC WATER
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

ACTIVATED CARBON
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Tying Up TCE,
W82-01866 5G

ACTIVATED SLUDGE PROCESS
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

ACUTE TOXICITY
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

ADIRONDACK REGION
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

ADSORPTION
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

AERATED LAGOONS
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

AERATION
Destratification and Reaeration as Tools for In-Lake Management.
W82-01648 5G

AERIAL PHOTOGRAPHY
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

AEROSOLS
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

AFRICA
Exploiting the Waters of Lake Chad.
W82-01726 8A

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

AGRICULTURAL CONSERVATION PROGRAM
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

AGRICULTURAL ENGINEERING
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

AGRICULTURAL RUNOFF
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

AGRICULTURAL WATERSHEDS
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 2A

AGRICULTURE
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Case Studies of Agricultural Water Conservation,
W82-01667 3F

AIR ENTRAINMENT
Excess Air in Groundwater,
W82-02099 2F

AIR POLLUTION
The Mercury Cycle,
W82-01869 5B

The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

AIR POLLUTION EFFECTS
Acid Precipitation,
W82-01607 5C

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

AIR POLLUTION SOURCES
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

ALABAMA
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

ALASKA
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

ALBERTA
Glacier Surveys in Alberta - 1979,
W82-01855 2C

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

ALGAE
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

ALGAL GROWTH
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

ALLEGHENY RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

ALLUVIAL RIVERS
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

ALTAMAHA RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

ALTERNATIVE PLANNING
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

ALTITUDE
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

ALUM
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

ALUMINUM
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

AMERICIUM
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

AMMONIA
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

ANADROMOUS FISH
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

ANAEROBIC DIGESTION
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

ANIMAL WASTES
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

Pollution from Farms,
W82-02039 5D

ANION EXCHANGE
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

ANTARCTIC
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

APPLES
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

AQUACULTURE
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

AQUATIC ANIMALS
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

AQUATIC DRIFT
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

AQUATIC ENVIRONMENT
Kinetics for the Aquatic Environment,
W82-01631 2K

Microbiology of the Aquatic Environment,
W82-01786 5C

Kinetics for the Aquatic Environment,
W82-01806 2K

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

AQUATIC FUNGI
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

AQUATIC LIFE
Microbiology of the Aquatic Environment,
W82-01786 5C

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

AQUATIC ORGANISMS
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

AQUATIC PLANTS
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

The Flowering of Wastewater Treatment,
W82-02015 5D

AQUATIC WEED CONTROL
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

AQUATIC WEEDS
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

AQUIFER CHARACTERISTICS
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

AQUIFER SYSTEMS
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

AQUIFERS
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

ARCATA
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

ARCH DAMS
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

ARCTIC
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

ARGENTINA
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

Reviving the Rio Reconquista,
W82-02014 5G

ARGON
Excess Air in Groundwater,
W82-02099 2F

ARKANSAS RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

AROMATIC COMPOUNDS
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

ARSENIC
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

ASBESTOS
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

ATHABASCA GLACIER
Glacier Surveys in Alberta - 1979,
W82-01855 2C

ATMOSPHERIC LOADING
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

ATMOSPHERIC WATER
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

ATOMIC ABSORPTION SPECTROSCOPY
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

AUFEIS FIELDS
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

AUGERS
Screened Auger Aids Investigation,
W82-02096 7B

AUSTRALIA
Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

Transport of Salts in Catchments and Soils,
W82-01880 2G

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

AUSTRIA
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

AUTOMATION
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

Where Do We Go from Here.
W82-02086 7A

AVAILABLE WATER
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

AWUIFERS
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

BACTERIA
Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay.
W82-01661 5A

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

BALTIC SEA
International Cooperation to Protect the Baltic,
W82-02087 6E

BAMBOO
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

BANANAS
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

BASELINE STUDIES
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

BASIN IRRIGATION
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

Development of Solutions for Level-Basin Design,
W82-01976 3F

BASINS
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

BED LOAD
Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

BELFAST LOUGH
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

BELIZE
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

BENTHIC FAUNA
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

BENTHOS
Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

BIBLIOGRAPHIES
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

BIGHTS
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

BIOACCUMULATION
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

BIOASSAY
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

BIOCHEMISTRY
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

BIODEGRADATION
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

BIOINDICATORS
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

BIOLOGICAL SAMPLES
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

BIOLOGICAL WASTEWATER TREATMENT
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

BIOMASS
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

BLACK RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

BLACK WARRIOR RIVER
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

BLEACHING WASTES
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

BORDER IRRIGATION
Optimal Design of Border Irrigation Systems,
W82-01977 3F

BOTTOM CURRENTS
Contourites in Lake Superior,
W82-01935 2H

BOTTOM SEDIMENTS
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

BRACKISH WATER
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

BRAZIL
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

BROMIDES
Bromide in Canterbury Ground Water,
W82-02056 5B

BROWN SOILS
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

BYPRODUCTS
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

CADMIUM
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

CALIFORNIA
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

CANADA
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

CANAL CONSTRUCTION
Exploiting the Waters of Lake Chad.
W82-01726 8A

CANALS
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

CAPE PENINSULA
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

CAPE TOWN
Cape Town Waterworks Service Reservoirs: Plattekloff (1974) and Tygerberg (1964).
W82-01747 8A

CARBOHYDRATES
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

CARBON CYCLE
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

CARBON DIOXIDE
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Summer Ice and Carbon Dioxide,
W82-01843 2C

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

CARCINOGENS
Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

CAROTENOIDS
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

CARP
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

CARRYING CAPACITY
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

CASE STUDIES
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

CASPIAN SEA
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

CATHODES
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

CATTLE
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

CENTRIFUGATION
Centrifugal Dewatering,
W82-01912 5E

CESIUM RADIOISOTOPES
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

CHAMBAL PROJECT
The Chambal Project: Problems and Solutions,
W82-01739 4A

CHANNEL MORPHOLOGY
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

CHELATING AGENTS
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

CHEMICAL ANALYSIS
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

CHEMICAL COMPOSITION
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

CHEMICAL PRECIPITATION
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

CHEMICAL PROPERTIES
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

CHEMICAL REACTIONS
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

CHEMICAL TREATMENT
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

CHEMICAL WASTES
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

Screened Auger Aids Investigation,
W82-02096 7B

CHEMICAL WASTEWATER
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

CHEMOCLINE
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

CHEMUNG COUNTY
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

CHESAPEAKE BAY
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

CHICAGO
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

CHINA
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

Impressions of Soil and Water Conservation in China,
W82-01730 4D

CHLORALKALI PLANTS
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

CHLORATES
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

CHLORINATION
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

CHLOROPHYLL
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

CHLOROPHYLL A
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

CHROMIUM
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

CITRUS FRUITS
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

CIVIL ENGINEERING
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

CLADOPHORA
Denitrification Associated With Periphyton Communities,
W82-01814 5B

CLARIFICATION
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

CLASSIFICATION
Water Quality Indices: An Additional Management Tool,
W82-01994 5G

CLEAR-CUTTING
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

CLIMATOLOGY
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

CLOUD PHYSICS
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

COAGULATION
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

COAL MINING
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

COASTAL AQUIFERS
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

COASTAL WATERS
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

COASTAL ZONE MANAGEMENT
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

COLIFORMS
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

COLOR REMOVAL
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

COLORADO
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

COLORADO RIVER BASIN
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

COLUMBIA RIVER
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

COMBINED TREATMENT
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

COMPREHENSIVE PLANNING
The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

COMPRESSIBILITY
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

COMPUTER PROGRAMS
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

CONDUCTIVITY
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

CONGRESSIONAL POLICY
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

CONJUNCTIVE USE
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

CONSERVATION
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

CONSUMPTIVE USE
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

CONTAMINATION
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

CONTOURS
Contourites in Lake Superior,
W82-01935 2H

CONVECTIVE PRECIPITATION
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

COOLING
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

COOLING WATER
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

COOPER
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

COPEPODS
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

COPPER
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

CORN
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

COST-BENEFIT ANALYSIS
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

COST SHARING
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

CRABS
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

CROP PRODUCTION
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

CROP YIELD
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Optimal Design of Border Irrigation Systems,
W82-01977 3F

CROPLAND
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

CRYSTAL GROWTH
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

CRYSTALLIZATION
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

CULTIVATION
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

CULTURE MEDIA
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

CULTURES
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

CULVERTS
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

Evaluating Scour at Culvert Outlets,
W82-01934 4D

CUMBERLAND RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

CURRENT METERS
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

CYCLING NUTRIENTS
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

CYPRESS DOMES
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

DAM CONSTRUCTION
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

DAM FOUNDATIONS
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

DAM STABILITY
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

DAMS
Recent Changes in Level of Lake Victoria,
W82-01711 4A

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

DAPHNIA
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

DATA ACQUISITION
Where Do We Go from Here.
W82-02086 7A

DATA COLLECTIONS
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

Where Do We Go from Here.
W82-02086 7A

DATA TRANSMISSION
Where Do We Go from Here.
W82-02086 7A

DECISION MAKING
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

Acid Rain and Environmental Policy,
W82-01987 5B

DECOMPOSITION
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

DEGRADATION
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

DEGREE-DAY FACTOR
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

DENITRIFICATION
Denitrification Associated With Periphyton Communities,
W82-01814 5B

DENSITY
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

DESALINATION
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

DESIGN CRITERIA
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

DESIGN FLOW
Statistical Determination of Design Low Flows,
W82-01858 2E

DESTRATIFICATION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

DEUTERIUM
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

DEVELOPING COUNTRIES
Remote Sensing in Development,
W82-01719 7B

Simplified Method for Rainfall Intensities,
W82-01978 2B

Wanted: Water for Development,
W82-02088 6D

Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

DIATOMS
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

DIFFUSION COEFFICIENT
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

DISCHARGE MEASUREMENT
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

DISEASES
Infectious Waterborne Diseases,
W82-01784 5A

DISINFECTION
Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

DISPERSIVITY
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

DISSOLVED OXYGEN
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

DISSOLVED SOLIDS
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

DISTILLATION
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

DISTRIBUTION
Development of Solutions for Level-Basin Design,
W82-01976 3F

DIVERSION
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

DIVERSION STRUCTURES
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

DORCHESTER COUNTY
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

DRAINAGE
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

The Chambal Project: Problems and Solutions,
W82-01739 4A

Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

DRAINAGE CANALS
Parish Is Not Liable for Subsidence.
W82-01603 6E

DRAWDOWN
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

DREDGING
Parish Is Not Liable for Subsidence.
W82-01603 6E

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

DRIFT
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

DRILLING EQUIPMENT
Screened Auger Aids Investigation,
W82-02096 7B

DRINKING WATER
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

DRIP IRRIGATION
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

DUNES
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

DUPUIT-FORCHHEIMER THEORY
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

DYE RELEASES
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

DYES
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

EARTH DAMS
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

ECOLOGICAL EFFECTS
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

ECONOMIC ANALYSIS
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

ECONOMIC ASPECTS
Case Studies of Agricultural Water Conservation,
W82-01667 3F

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

Long-Run Effects of Environmental Regulation,
W82-01848 6A

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

ECONOMIC FEASIBILITY
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

ECONOMICS
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

ECOSYSTEMS
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

The Modeling of Aquatic Ecological Systems,
W82-01972 5B

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

EFFLUENT CHARGES
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

EFFLUENT STANDARDS
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

EFFLUENTS
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

EGGS
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

EGYPT
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

ELECTRIC POWER PRODUCTION
Severn Barrage Scheme Gets Favourable Response.
W82-02089 6B

ELECTRIC POWERPLANTS
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

ELECTROCHEMISTRY
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

EMISSION SPECTROSCOPY
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

ENERGY DISSIPATION
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

ENERGY EQUATION
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

ENGLAND
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

Slowhill Copse Sewage Treatment Works.
W82-01727 5D

Operating Policies for a Surface/Ground Water System,
W82-01741 4B

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

ENTEROVIRUSES
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

ENVIRONMENTAL EFFECTS
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

ENVIRONMENTAL EFFECTS. *POLLUTANT IDENTIFICATION
Organic Substances in Water,
W82-01783 5A

ENVIRONMENTAL PROTECTION
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

International Cooperation to Protect the Baltic,
W82-02087 6E

ENZYMES
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

EPIDEMIOLOGY
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

EQUILIBRIUM
Kinetics for the Aquatic Environment,
W82-01806 2K

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

EROSION
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

Evaluating Scour at Culvert Outlets,
W82-01934 4D

EROSION CONTROL
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

ERROR ANALYSIS
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

ERRORS
Note on Random Raindrops and Sampling Error,
W82-02032 2B

ESTUARIES
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

ESTUARINE ENVIRONMENT
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

EUTROPHIC LAKES
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

EUTROPHICATION
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

EVALUATION
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

EVAPORATION
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

EVAPOTRANSPIRATION
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

EXCESS RAINFALL
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

EXPERIMENTAL FARMS
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

FABRICS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

FALLOUT
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

FARM WASTES
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

Pollution from Farms,
W82-02039 5D

FARMING
Logistics of Farm Water Supply.
W82-02037 6A

FATE OF POLLUTANTS
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

Environmental Fate of Methyl Eugenol,
W82-02013 5B

FEDERAL REPUBLIC OF GERMANY
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

FEEDLOT RUNOFF
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

FEEDLOT WASTES
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

FEEDLOTS
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

FERMENTATION
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

FERTILIZERS
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

FILMS
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

FILTERS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

FILTRATION
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

FINANCING
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

FINLAND
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

FISH
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

FISH BARRIERS
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

FISH FARMING
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

FISH FOOD
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

FISH MANAGEMENT
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

FISH PHYSIOLOGY
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

FISH PONDS
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

FISH POPULATIONS
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

FISHERIES
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

FISHKILL
Acid Precipitation,
W82-01607 5C

FJORDS
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

FLASH FLOODS
Learning from the Skipton Flood,
W82-02063 2E

FLOCCULATION
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

FLOOD CONTROL
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

The Chambal Project: Problems and Solutions,
W82-01739 4A

Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

The Day That the Rain Came Down,
W82-02064 2E

FLOOD DAMAGE
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

The Day That the Rain Came Down,
W82-02064 2E

FLOOD FORECASTING
Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Learning from the Skipton Flood,
W82-02063 2E

FLOOD FREQUENCY
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

FLOOD PEAK
Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Legal Challenge of the Ungaged Watershed,
W82-01664 2E

FLOOD PLAIN MANAGEMENT
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

FLOOD PROTECTION
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

FLORIDA
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

FLOTATION
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

FLOW
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

FLOW DURATION
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

FLOW NETS
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

FLOW PATTERNS
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

FLOW RATES
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

FLUCTUATIONS
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

FLUVIAL SEDIMENTS
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

FOAM SEPARATION
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

FOOD CHAINS
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

FOOD-PROCESSING WASTES
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

FORECASTING
The Modeling of Aquatic Ecological Systems,
W82-01972 5B

Learning from the Skipton Flood,
W82-02063 2E

FOREST MANAGEMENT
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

FRANCE
Sustaining the Growth of Provence.
W82-01738 6D

FREQUENCY ANALYSIS
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

FRUIT CROPS
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

FUNGI
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

FURROW IRRIGATION
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

GAS CHROMATOGRAPHY
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

GEOCHEMISTRY
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

GEOHYDROLOGIC UNITS
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

GEOHYDROLOGY
Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

GEOLOGY
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GERMAN DEMOCRATIC REPUBLIC
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

GERMANIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

GERMANY
Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

GLACIAL AQUIFERS
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GLACIERS
Glacier Surveys in Alberta - 1979,
W82-01855 2C

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

GLACIOHYDROLOGY
Glacier Surveys in Alberta - 1979,
W82-01855 2C

GLOBAL CLIMATE CHANGE
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

GOOSE CREEK
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

GRAIN CROPS
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

GRAND RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

GRAPHICAL ANALYSIS
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

GREAT BRITAIN
Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

Recording Underground,
W82-02036 8A

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

Learning from the Skipton Flood,
W82-02063 2E

The Day That the Rain Came Down,
W82-02064 2E

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

GREAT LAKES
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

GREAT LAKES TRIBUTARIES
Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

GREEN LAKE
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

GROUNDWATER
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Groundwater Levels in Nebraska 1980,
W82-01785 2F

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

Applications of Aerial Photography,
W82-01988 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

GROUNDWATER AVAILABILITY
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

GROUNDWATER BASINS
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

GROUNDWATER HYDROLOGY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

GROUNDWATER LEVEL
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

GROUNDWATER MANAGEMENT
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

GROUNDWATER MOVEMENT
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

GROUNDWATER POLLUTION
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

Tying Up TCE,
W82-01866 5G

Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

Bromide in Canterbury Ground Water,
W82-02056 5B

Screened Auger Aids Investigation,
W82-02096 7B

GROUNDWATER POTENTIAL
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GROUNDWATER RUNOFF
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

GROUNDWATER STORAGE
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

GROUTING
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

GROWTH
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

GULF OF MEXICO
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

GULF OF MEXICO STATES
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

HABITATS
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

HAIL
Various Kinetic Energy Characteristics of Hailpatterns in the Grossversuch IV Experiment,
W82-01732 2B

HALOPHYTES
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

HARBORS
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

HAY
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

HAZARDOUS MATERIALS
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

The Hazards of Hazardous Waste Management,
W82-01940 6E

HEAT TRANSFER
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

HEATED WATER
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

HEAVY METALS
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

Pollution Solutions--The Wire Drawing Industry.
W82-02041 5D

HERBICIDES
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

HETEROGENEITY
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

HEXACHLOROCYCLOPENTADIENE
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

HONG KONG
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

HUDSON RIVER ESTUARY
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

HYDRAULIC CONDUCTIVITY
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

HYDRAULIC GEOMETRY
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

HYDRAULIC GRADIENT
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

HYDRAULIC MODELS
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

HYDRAULIC PROPERTIES
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

HYDROCARBONS
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

HYDROELECTRIC PLANTS
Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

HYDROELECTRIC POWER
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

HYDROGEN ION CONCENTRATION
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

HYDROGEN SULFIDE
Reviving the Rio Reconquista,
W82-02014 5G

HYDROLOGIC BUDGET
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

HYDROLOGIC CYCLE
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

HYDROLOGIC DATA
Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 2A

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

HYDROLOGIC MAPS
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

HYDROLOGICAL REGIME
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

HYDROPHYTES
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

ICE
Summer Ice and Carbon Dioxide,
W82-01843 2C

ILLINOIS
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

Water Quality and the Demand for Recreation,
W82-01942 6D

IMPAIRED WATER QUALITY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

INDIA
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

The Chambal Project: Problems and Solutions,
W82-01739 4A

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

INDIANA
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

INDUSTRIAL PLANTS
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

INDUSTRIAL WASTES
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 5B

Bromide in Canterbury Ground Water,
W82-02056 5B

Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

Poland: Coming to Grips with Pollution,
W82-02092 5G

INDUSTRIAL WASTEWATER
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

INDUSTRIAL WATER
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

INFECTION
Infectious Waterborne Diseases,
W82-01784 5A

INFILTRATION
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

INFILTRATION RATE
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

INGURI DAM
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

INSECTICIDES
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

INSTREAM FLOW
Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

INTAKES
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

INTERNATIONAL AGREEMENTS
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

Acid Rain Agreement,
W82-01933 5B

INTERNATIONAL COMMISSIONS
International Cooperation to Protect the Baltic,
W82-02087 6E

INTERNATIONAL WATERS
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

INVERTEBRATES
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

ION EXCHANGE
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

IONS
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

IOWA
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

IRRIGATION
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

Agricultural Conservation Program: An Evaluation,
W82-02019 3F

IRRIGATION DESIGN
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

IRRIGATION EFFECTS
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

IRRIGATION EFFICIENCY
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

Development of Solutions for Level-Basin Design,
W82-01976 3F

Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

IRRIGATION PRACTICES
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

IRRIGATION PROGRAMS
Integrated Agricultural Development in the Philippines,
W82-01725 6B

Exploiting the Waters of Lake Chad.
W82-01726 8A

Sustaining the Growth of Provence.
W82-01738 6D

The Chambal Project: Problems and Solutions,
W82-01739 4A

Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

IRRIGATION REQUIREMENTS
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Optimal Design of Border Irrigation Systems,
W82-01977 3F

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

IRRIGATION WATER
Impressions of Soil and Water Conservation in China,
W82-01730 4D

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

IRTYSH-KARAGANDA CANAL
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

ISLE OF MAN
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

ISOTOPE STUDIES
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

ISRAEL
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

JAMES BAY
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

JAMES RIVER
Protecting Virginia's Waterways,
W82-01608 5G

Sediment-Contaminant Transport Model,
W82-01614 5B

JORDAN
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

JUDICIAL DECISIONS
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

KANEV RESERVOIR
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

KANSAS
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

KARST HYDROLOGY
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

KENNEBEC RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

KEPONE
Protecting Virginia's Waterways,
W82-01608 5G

Sediment-Contaminant Transport Model,
W82-01614 5B

Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

KHARKOV
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

KIEV RESERVOIR
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

KIEV RESERVOIRS
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

KINETIC ENERGY
Various Kinetic Energy Characteristics of Hail-patterns in the Grossversuch IV Experiment,
W82-01732 2B

KINETICS
Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

KREMENCHUG RESERVOIR
Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

KRIGING
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

LABORATORY EQUIPMENT
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

LADOGA LAKE
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

LAGOONS
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

LAKE BAIKAL
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

LAKE BEDS
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

LAKE CHAD
Exploiting the Waters of Lake Chad.
W82-01726 8A

LAKE ERIE
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

LAKE HURON
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

LAKE KNAACK
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

LAKE LUCERNE
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

LAKE MEMPHREMAGOG
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

LAKE MICHIGAN
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

LAKE MORPHOMETRY
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

LAKE NASSER
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

LAKE NEUSIEDLER
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

LAKE OGLETHROPE
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

LAKE ONTARIO
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

LAKE REREWHAKAAITU
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

LAKE RESTORATION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

LAKE SEDIMENTS
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

LAKE ST. CLAIR
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

LAKE SUPERIOR
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

Contourites in Lake Superior,
W82-01935 2H

LAKE TAHOE
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

LAKE TAUPO
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

LAKE VICTORIA
Recent Changes in Level of Lake Victoria,
W82-01711 4A

LAKES
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Recent Changes in Level of Lake Victoria,
W82-01711 4A

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

The Mercury Cycle,
W82-01869 5B

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

Contourites in Lake Superior,
W82-01935 2H

Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

LAND DISPOSAL
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

LAND USE
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

LANDFILLS
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

LANGMUIR CELLS
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

LARVICIDES
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

LEACHATES
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

LEACHING
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

LEAKY AQUIFERS
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

LEECHES
The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

LEGAL ASPECTS
Parish Is Not Liable for Subsidence.
W82-01603 6E

The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

Perseverance Produces County Park,
W82-01932 6D

LEGISLATION
Pollution Control: Changing Approaches,
W82-01870 6E

LIGHT PENETRATION
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

LIME
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

LIMNOLOGY
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

Limnology of Lake Rerewhakaaitu,
W82-01705 2H

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

LINDANE
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

LITERATURE REVIEW
Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

LIVESTOCK
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

LOG PEARSON DISTRIBUTION
Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

LOGGING
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

LONG-TERM PLANNING
Long-Run Effects of Environmental Regulation,
W82-01848 6A

LOUISIANA
Parish Is Not Liable for Subsidence.
W82-01603 6E

LOVE CANAL
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

LOW FLOW
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Statistical Determination of Design Low Flows,
W82-01858 2E

MACROINVERTEBRATES
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

MACROPHYTES
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

MAIN SEWERS
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

MAPPING
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

MAPS
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

Recording Underground,
W82-02036 8A

MARGINAL COSTS
Charging Policies for Water Services,
W82-01734 6C

MARINE SEDIMENTS
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

MARSHES
Upland Marsh for Water Quality Control,
W82-01962 5B

MASS TRANSFER
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

MASS TRANSPORT
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

MATACIL
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

MATHEMATICAL EQUATIONS
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

MATHEMATICAL MODELS
Random Differential Equations in Water Quality Modeling,
W82-01688 6A

A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

Mixing Zone Analysis for River Plumes,
W82-01961 5B

The Modeling of Aquatic Ecological Systems,
W82-01972 5B

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

MATHEMATICAL STUDIES
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Kinetics for the Aquatic Environment,
W82-01631 2K

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

MEASURING INSTRUMENTS
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

MECHANICAL EQUIPMENT
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

MELT WATER
Glacier Surveys in Alberta - 1979,
W82-01855 2C

MEMBRANE FILTERS
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

MENOMINEE RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

MERCURY
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

The Mercury Cycle,
W82-01869 5B

MEROMICTIC LAKES
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

MESOTROPHIC LAKES
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

METAL *ANALYTICAL TECHNIQUES
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

METAL-FINISHING WASTES
Managing Water at Helicopter Plant,
W82-01974 5D

A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

METALS
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

METEOROLOGICAL DATA
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

METHANE
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

METHANE BACTERIA
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

METHEMOGLOBINEMIA
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

METHYL EUGENOL
Environmental Fate of Methyl Eugenol,
W82-02013 5B

METHYLATION
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

MEXICO
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

MIAMI
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

MICROBIAL DEGRADATION
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MICROBIOLOGICAL STUDIES
Microbiology of the Aquatic Environment,
W82-01786 5C

MICROORGANISMS
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

MINE DRAINAGE
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

MINE WASTES
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

MINERAL INDUSTRY
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

MINERAL WATER REACTIONS
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

MINERALS
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

MIREX
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

MISSISSIPPI
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

MISSISSIPPI RIVER
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

MISSOURI RIVER
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

MIXING
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

MODEL STUDIES
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Kinetics for the Aquatic Environment,
W82-01631 2K

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

Random Differential Equations in Water Quality Modeling,
W82-01688 6A

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Pollution Permits and Markets for Water Quality,
W82-01699 6A

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

MONITORING
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Where Do We Go from Here.
W82-02086 7A

MONTANA
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

MONTE CARLO METHOD
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

MOROCCO
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

MOSCOW RIVER
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

MOST PROBABLE NUMBER TEST
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

MOUNT ST. HELENS
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

MULTIOBJECTIVE PLANNING
The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

MUNICIPAL WASTES
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

MUNICIPAL WATER
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

MURFREESBORO
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

MUSSELS
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

MUTAGENS
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

NANNOPLANKTON
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

NANTICOKE THERMAL GENERATING STATION
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

NATURAL RESOURCES
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

NATURAL STREAMS
Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

NATURAL WATERS
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

NEBRASKA
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

Groundwater Levels in Nebraska 1980,
W82-01785 2F

NENT RIVER
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

NETHERLANDS
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

NEW JERSEY
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

NEW YORK
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

NEW ZEALAND
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Limnology of Lake Rerewhakaaitu,
W82-01705 2H

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

Logistics of Farm Water Supply.
W82-02037 6A

Bromide in Canterbury Ground Water,
W82-02056 5B

NICKEL
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

NIGERIA
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

NILE BASIN
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

NILE RIVER
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

NITRATE
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

NITRATE REMOVAL
Tackling the Nitrate Problem.
W82-01874 5F

NITRATES
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

Tackling the Nitrate Problem.
W82-01874 5F

Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

NITRIFICATION
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

NITROGEN
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Excess Air in Groundwater,
W82-02099 2F

NITROGEN CYCLE
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

NITROGEN FIXING BACTERIA
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

NITROUS OXIDE
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

NORTH CAROLINA
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

NORTHERN IRELAND
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

NORTHWEST TERRITORIES
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

NORWAY
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

NUCLEAR ENERGY
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

NUMERICAL ANALYSIS
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

NUTRIENT REMOVAL
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

NUTRIENTS
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

OBSERVATION WELLS
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

OCEAN CIRCULATION
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

OCEAN DUMPING
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

ODORS
Reviving the Rio Reconquista,
W82-02014 5G

OIL POLLUTION
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

OIL SHALE
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

OIL-WATER INTERFACES
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

OKLAHOMA
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

OLIGOTROPHIC LAKES
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

OPOSSUM SHRIMP
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

OREGON
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

ORGANIC ACIDS
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

ORGANIC CARBON
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

ORGANIC COMPOUNDS
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Organic Substances in Water,
W82-01783 5A

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

Tying Up TCE,
W82-01866 5G

Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

ORGANIC MATTER
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

ORGANIC SOILS
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

ORGANOPHOSPHORUS COMPOUNDS
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

ORGANOPHOSPHORUS PESTICIDES
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

OROGRAPHIC PRECIPITATION
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

OSCILLATORY WAVES
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

OUTLETS
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

OVERLAND FLOW
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

OXIDATION
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

OXYGEN
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

OXYGEN DEPLETION
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

PACKED BEDS
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

PARAGUAY
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

PARASITE
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

PARASITES
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

PARKS
Perseverance Produces County Park,
W82-01932 6D

Water Quality and the Demand for Recreation,
W82-01942 6D

PARTICLE SIZE
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

PARTICULATE MATTER
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

PATH OF POLLUTANTS
Sediment-Contaminant Transport Model,
W82-01614 5B

A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

The Mercury Cycle,
W82-01869 5B

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

PAWTUXET RIVER
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

PEACHES
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

PENNSYLVANIA
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

PENOBSCOT RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

PERMAFROST
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

PERMEABILITY COEFFICIENT
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

PESTICIDE KINETICS
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

PESTICIDE RESIDUES
Protecting Virginia's Waterways,
W82-01608 5G

Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

PESTICIDES
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

Environmental Fate of Methyl Eugenol,
W82-02013 5B

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

PETROLEUM PRODUCTS
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

PHENOLS
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

PHILIPPINES
Integrated Agricultural Development in the Philippines,
W82-01725 6B

PHOSPHORUS
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

PHOSPHORUS COMPOUNDS
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

PHOSPHORUS REMOVAL
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

PHOTOMETRY
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

PHOTOSYNTHESIS
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

PHYSICAL PROPERTIES
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

PHYTOPLANKTON
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

PIPE FAILURE
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

PLANE FLOW
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

PLANKTON
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

PLANNING
Reviving the Rio Reconquista,
W82-02014 5G

PLANT NUTRIENT UPTAKE
Upland Marsh for Water Quality Control,
W82-01962 5B

PLANT POPULATIONS
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

PLASTICS
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

PLAYAS
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

PLUG FLOW
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

POLAND
Poland: Coming to Grips with Pollution,
W82-02092 5G

POLICY MAKING
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

POLITICAL ASPECTS
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

POLITICAL CONSTRAINTS
Acid Rain Agreement,
W82-01933 5B

POLLUTANT IDENTIFICATION
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

Infectious Waterborne Diseases,
W82-01784 5A

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

POLLUTANTS
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

POLLUTION ABATEMENT
Pollution Permits and Markets for Water Quality,
W82-01699 6A

POLLUTION LOAD
Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

POLLUTION TAXES
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

POLYCHLORINATED BIPHENYLS
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

PONDS
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

POPULATION DENSITY
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

POPULATION DYNAMICS
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

PORT VALDEZ
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

POTABLE WATER
A Survey of Trihalomethanes in the Drinking Water System of Murfreesboro, Tennessee,
W82-01817 5B

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

POTENTIOMETRIC HEAD
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

POTOMAC RIVER BASIN
Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

POWERPLANTS
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

PRECIPITAION
Hydrologic Data for Experimental Agricultural Watersheds in the United States, 1972,
W82-01772 2A

PRECIPITATION
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

Simplified Method for Rainfall Intensities,
W82-01978 2B

PRECIPITATION INTENSITY
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

PREDICTION
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

PRICING
Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

PRIORITIES
The Sewerage Policy of Thames Water,
W82-02040 6E

PRIORITY POLLUTANTS
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

PROBABILISTIC PROCESS
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

PRODUCTIVITY
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

PROJECT PLANNING
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

PROTOZOA
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

PUBLIC HEALTH
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

Wanted: Water for Development,
W82-02088 6D

PUBLIC POLICY
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

PUBLICATIONS
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

PULP AND PAPER INDUSTRY
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

PUMPING TESTS
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

RADAR
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

RADIOACTIVE TRACERS
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

RADIOACTIVITY
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

RADIOISOTOPES
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

RAIN GAGES
Note on Random Raindrops and Sampling Error,
W82-02032 2B

RAINBOW TROUT (SALMO GAIRDNERI)
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

RAINFALL
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

Note on Random Raindrops and Sampling Error,
W82-02032 2B

RAINFALL IMPACT
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

RAINFALL INTENSITY
Simplified Method for Rainfall Intensities,
W82-01978 2B

RAINFALL-RUNOFF RELATIONSHIPS
Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

RAINWATER
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

RAPESEED
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

RAVENGLASS ESTUARY
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

RECHARGE
Excess Air in Groundwater,
W82-02099 2F

RECLAIMED WATER
Managing Water at Helicopter Plant,
W82-01974 5D

RECREATION DEMAND
Water Quality and the Demand for Recreation,
W82-01942 6D

RECREATION FACILITIES
Reconstruction of a Small Dam for a Recreational Lake.
W82-01604 4D

RECYCLING
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

RED RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

RED TIDE
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

REGULATED FLOW
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

REGULATIONS
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

Long-Run Effects of Environmental Regulation,
W82-01848 6A

Pollution Control: Changing Approaches,
W82-01870 6E

Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

REMOTE SENSING
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Remote Sensing in Development,
W82-01719 7B

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

Applications of Aerial Photography,
W82-01988 7B

RESEARCH FACILITIES
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

RESERVOIR
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

RESERVOIR CONSTRUCTION
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

RESERVOIR DESIGN
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

RESERVOIR FILLING
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

RESERVOIR OPERATION
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

RESERVOIR RELEASES
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

RESERVOIR SILTING
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

RESERVOIR STAGES
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

RESERVOIRS
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

Cape Town Waterworks Service Reservoirs: Platteklоff (1974) and Tygerberg (1964).
W82-01747 8A

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

RESIDENCE TIME
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

RESONANCE
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

RESOURCES DEVELOPMENT
Integrated Agricultural Development in the Philippines,
W82-01725 6B

RESOURCES MANAGEMENT
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

RESPIRATION
A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

RETENTION TIME
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

RHINE RIVER
Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

RHIZOSPHERE
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

RHODESIA
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

RIVER BASIN DEVELOPMENT
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

RIVER BASINS
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

RIVERS
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

ROCKFILL DAMS
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

ROCKS
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

ROOT DEVELOPMENT
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

ROOT ZONE
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

ROTIFERS
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

RUNOFF
Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

RUNOFF FORECASTING
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

RUSSIA
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

SAFE YIELD
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

SAFFLOWER
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

SAGINAW BAY
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

SAGINAW RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

SAGUENAY FJORD
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

SALINE SOILS
Transport of Salts in Catchments and Soils,
W82-01880 2G

A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SALINE WATER
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SALINE WATER INTRUSION
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

SALINITY
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

SALINITY CURRENTS
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

SALMON
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

SALMONELLA
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

SALT LOADING
Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

SALT MARSHES
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

SALT VALLEY
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

SALTS
Transport of Salts in Catchments and Soils,
W82-01880 2G

SAMPLE PRESERVATION
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

SAMPLING
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

Note on Random Raindrops and Sampling Error,
W82-02032 2B

SAND MOUNDS
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

SANITATION
Wanted: Water for Development,
W82-02088 6D

SANTEE RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

SAPROBITY
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

SASKATCHEWAN GLACIER
Glacier Surveys in Alberta - 1979,
W82-01855 2C

SATELLITE TECHNOLOGY
Remote Sensing in Development,
W82-01719 7B

Spatial Simulation of Snow Processes,
W82-01887 2C

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

SATURATION ZONE
Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

SCOUR
Evaluating Scour at Culvert Outlets,
W82-01934 4D

SEA LEVEL
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

SEASONAL VARIATION
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

SEAWATER
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

SECONDARY WASTEWATER TREATMENT
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

SEDIMENT DEPOSITION
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

SEDIMENT DISCHARGE
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

SEDIMENT LOAD
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

SEDIMENT TRANSPORT
Sediment-Contaminant Transport Model,
W82-01614 5B

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

SEDIMENT YIELD
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

SEDIMENTATION RATES
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

SEDIMENTS
Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

SEDIPAC CLARIFIER
Pollution Solutions--The Wire Drawing Industry.
W82-02041 5D

SEEPAGE
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

SEISMICITY
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

SELENIUM
Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 5B

SELF-PURIFICATION
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

SEMIARID LANDS
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

SENEGAL RIVER
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

SEPARATION TECHNIQUES
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

SESTON
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

SEVERN ESTUARY
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

SEVERN RIVER
Severn Barrage Scheme Gets Favourable Response.
W82-02089 6B

SEWERAGE
The Sewerage Policy of Thames Water,
W82-02040 6E

SEWERS
Recording Underground,
W82-02036 8A

SHARPTOWN
The Hazards of Hazardous Waste Management,
W82-01940 6E

SHELLFISH
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

SHRIMP
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

SILENIUM
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

SILTING
Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

SIMULATION ANALYSIS
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

SINKS
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

SITE SELECTION
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

SITES
Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

SLOPE STABILITY
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

SLUDGE DISPOSAL
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

Centrifugal Dewatering,
W82-01912 5E

SLUDGE DRYING
Centrifugal Dewatering,
W82-01912 5E

SLUDGE LAGOONS
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

SNOW ACCUMULATION
Spatial Simulation of Snow Processes,
W82-01887 2C

SNOW COVER
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

SNOWMELT
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

Spatial Simulation of Snow Processes,
W82-01887 2C

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

SOCIAL ASPECTS
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

SODIUM POLYSULFIDE
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

SOIL ABSORPTION CAPACITY
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

SOIL COLUMNS
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

SOIL CONSERVATION
Impressions of Soil and Water Conservation in China,
W82-01730 4D

Agricultural Conservation Program: An Evaluation,
W82-02019 3F

SOIL EROSION
Impressions of Soil and Water Conservation in China,
W82-01730 4D

Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

SOIL GASES
Excess Air in Groundwater,
W82-02099 2F

SOIL MOISTURE
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

SOIL PROPERTIES
Transport of Salts in Catchments and Soils,
W82-01880 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

SOIL RECLAMATION
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SOIL WATER
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

SOIL-WATER-PLANT RELATIONSHIPS
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

SOLUTE TRANSPORT
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

SORGHUM
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

SORPTION
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

SOUTH AFRICA
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

SOUTH DAKOTA
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

SOUTHAMPTON
Slowhill Copse Sewage Treatment Works.
W82-01727 5D

SOYBEANS
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

SPATIAL DISTRIBUTION
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

SPECIES COMPOSITION
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

SPECIES DIVERSITY
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

SPECIFIC CONDUCTIVITY
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

SPOIL DISPOSAL
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

SPRINGS
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

SPRINKLE IRRIGATION
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

ST. LAWRENCE ESTUARY
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

STABILITY ANALYSIS
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

STABILIZATION PONDS
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

STAGE-DISCHARGE RELATIONS
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

STANDING CROPS
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

STATISTICAL MECHANICS
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

STATISTICAL METHODS
Statistical Determination of Design Low Flows,
W82-01858 2E

STATISTICS
Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

STOCHASTIC PROCESS
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

STOMATAL TRANSPIRATION
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

STORM-OVERFLOW SEWERS
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

STORM RUNOFF
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

STORM WATER
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

STREAM BIOTA
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

STREAM DISCHARGE
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

STREAMFLOW
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

STREAMFLOW FORECASTING
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

STREAMS
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

STREPTOCOCCUS BOVIS
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

SUBARCTIC ZONE
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

SUBSIDENCE
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

SUBSTRATES
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

SULFUR
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

SULFUR CYCLE
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

SUMAS RIVER BASIN
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

SURFACE-GROUNDWATER RELATIONS
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

SURFACE TENSION
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

SURFACE WATER
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

SURFACE WATERS
Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

SURFACTANTS
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

SURGES
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

SURVEYS
Case Studies of Agricultural Water Conservation,
W82-01667 3F

SUSPENDED SEDIMENT
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

SUSPENDED SEDIMENTS
Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

SWAMPS
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

SWARTVLEI LAKE
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

SWEDEN
The Mercury Cycle,
W82-01869 5B

Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

SWIMMING POOLS
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

SWITZERLAND
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

SYMBIOSIS
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

SYSTEMS ANALYSIS
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

TAIWAN
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

TANNERY WASTES
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

TANNINS
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

TAXONOMY
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

TECHNICAL SOCIETIES
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

TECTONICS
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

TEES RIVER
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

TEMPERATURE EFFECTS
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

Mixing Zone Analysis for River Plumes,
W82-01961 5B

TENNESSEE
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

TENNESSEE RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

TERRACING
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

TEST WELLS
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

TEXTILE MILL WASTES
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

THAMES WATER AUTHORITY
The Sewerage Policy of Thames Water,
W82-02040 6E

THEORETICAL ANALYSIS
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

THERMAL POLLUTION
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

Mixing Zone Analysis for River Plumes,
W82-01961 5B

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

THERMAL POWERPLANTS
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

THERMAL PROPERTIES
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

THERMAL STRATIFICATION PREVENTION
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

THERMAL WATER
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

THERMOCLINE
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

THUNDERSTORMS
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

TIBER RIVER
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

TIDAL EFFECTS
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

TIDAL POWERPLANTS
Severn Barrage Scheme Gets Favourable Response.
W82-02089 6B

TIDAL RIVERS
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

TIDES
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

TILLATOBA CREEK BASIN
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

TIME OF TRAVEL
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

TIME SERIES ANALYSIS
Upland Marsh for Water Quality Control,
W82-01962 5B

TITANIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

TOLO HARBOUR
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

TOMATOES
Environmental Fate of Methyl Eugenol,
W82-02013 5B

TOMBIGBEE-WARRIOR RIVER BASIN
Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

TOPOGRAPHY
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

TORONTO
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

TOXICITY
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

TRACE METALS
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

TRACERS
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

TREES
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

TRICHLOROETHYLENE
Tying Up TCE,
W82-01866 5G

TRICKLE IRRIGATION
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

TRICKLING FILTERS
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

TRIHALOMETHANES
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

TRITIUM
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

TROPHIC LEVEL
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

TROUT
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

TUCSON
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

TURBULENT FLOW
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

UKRAINE
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

ULTRAFILTRATION
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

UNITED KINGDOM
Charging Policies for Water Services,
W82-01734 6C

Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

Centrifugal Dewatering,
W82-01912 5E

The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

Water Quality Indices: An Additional Management Tool,
W82-01994 5G

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

UNSATURATED FLOW
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

USER CHARGES
Charging Policies for Water Services,
W82-01734 6C

USSR
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

UTAH
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

VANADIUM
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

VARIABILITY
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

VARIATION COEFFICIENTS
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

VELOCITY
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

VIBRIO
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

VIBRIO PARAHAEMOLYTICUS
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

VICTORIA
Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

VILYUY RESERVOIR
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

VIRUSES
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

VOLCANOES
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

VOLGA DELTA
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

WABIGOON RIVER BASIN
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

WALES
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

WARNING SYSTEMS
The Day That the Rain Came Down,
W82-02064 2E

WASHINGTON
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

WASTE DISPOSAL
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

WASTE DUMPS
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

WASTE MANAGEMENT
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

The Hazards of Hazardous Waste Management,
W82-01940 6E

WASTE RECOVERY
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

WASTE STORAGE
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

WASTE TREATMENT
Pollution from Farms,
W82-02039 5D

WASTES
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

WASTEWATER
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

WASTEWATER ANALYSIS
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

WASTEWATER DISPOSAL
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

WASTEWATER FACILITIES
Slowhill Copse Sewage Treatment Works.
W82-01727 5D

Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

WASTEWATER LAGOONS
Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

WASTEWATER POLLUTION
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

WASTEWATER RENOVATION
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

WASTEWATER TREATMENT
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

Slowhill Copse Sewage Treatment Works.
W82-01727 5D

Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

The Flowering of Wastewater Treatment,
W82-02015 5D

Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

WATER ALLOCATION

Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

WATER ANALYSIS

Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

WATER BALANCE

A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

WATER CIRCULATION

A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

WATER CONSERVATION

Case Studies of Agricultural Water Conservation,
W82-01667 3F

Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

WATER CONVEYANCE

Logistics of Farm Water Supply.
W82-02037 6A

WATER COOLING

Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

WATER COSTS

Managing Water at Helicopter Plant,
W82-01974 5D

WATER CURRENTS

Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

WATER DEFICIT

Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

WATER DEMAND

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

WATER HAMMER

Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

WATER HYACINTH

The Flowering of Wastewater Treatment,
W82-02015 5D

WATER LEVEL

Recent Changes in Level of Lake Victoria,
W82-01711 4A

Groundwater Levels in Nebraska 1980,
W82-01785 2F

Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

WATER LEVEL FLUCTUATIONS

The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

Groundwater Levels in Nebraska 1980,
W82-01785 2F

WATER MAINS

Recording Underground,
W82-02036 8A

WATER MANAGEMENT

Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

WATER MANAGMENT

Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

WATER METERING

Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

WATER POLICY

The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Charging Policies for Water Services,
W82-01734 6C

The Sewerage Policy of Thames Water,
W82-02040 6E

Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

WATER POLLUTION

The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

The Mercury Cycle,
W82-01869 5B

Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

WATER POLLUTION CONTROL

Pollution Permits and Markets for Water Quality,
W82-01699 6A

WATER POLLUTION CONTROL

Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

Long-Run Effects of Environmental Regulation,
W82-01848 6A

Pollution Control: Changing Approaches,
W82-01870 6E

Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

Reviving the Rio Reconquista,
W82-02014 5G

Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

Poland: Coming to Grips with Pollution,
W82-02092 5G

WATER POLLUTION EFFECTS

Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

Acid Precipitation,
W82-01607 5C

An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

Infectious Waterborne Diseases,
W82-01784 5A

Microbiology of the Aquatic Environment,
W82-01786 5C

Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

WATER POLLUTION PREVENTION

Protecting Virginia's Waterways,
W82-01608 5G

Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

WATER POLLUTION SOURCES

Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

The Hazards of Hazardous Waste Management,
W82-01940 6E

The Modeling of Aquatic Ecological Systems,
W82-01972 5B

Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

Poland: Coming to Grips with Pollution,
W82-02092 5G

WATER PRESSURE

Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

WATER QUALITY

The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

Random Differential Equations in Water Quality Modeling,
W82-01688 6A

Pollution Permits and Markets for Water Quality,
W82-01699 6A

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

Organic Substances in Water,
W82-01783 5A

Infectious Waterborne Diseases,
W82-01784 5A

Microbiology of the Aquatic Environment,
W82-01786 5C

Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

Water Quality and the Demand for Recreation,
W82-01942 6D

Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

WATER QUALITY CONTROL

Protecting Virginia's Waterways,
W82-01608 5G

Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

Upland Marsh for Water Quality Control,
W82-01962 5B

Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

WATER QUALITY INDICES

Water Quality Indices: An Additional Management Tool,
W82-01994 5G

WATER QUALITY MANAGEMENT
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

Water Quality Indices: An Additional Management Tool,
W82-01994 5G

WATER QUALITY STANDARDS
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

WATER RATES
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

WATER REQUIREMENTS
Water Requirements and Man-Induced Climate Change,
W82-01633 2D

Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

WATER RESOURCES
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

WATER RESOURCES DEVELOPMENT
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

Remote Sensing in Development,
W82-01719 7B

Impressions of Soil and Water Conservation in China,
W82-01730 4D

Sustaining the Growth of Provence.
W82-01738 6D

Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

WATER RESOURCES MANAGEMENT
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

WATER REUSE
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

WATER RIGHTS
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

WATER SAMPLING
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

WATER SOURCES
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

WATER STORAGE
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

WATER STRESS
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

WATER SUPPLY
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

WATER SUPPLY DEVELOPMENT
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

Impressions of Soil and Water Conservation in China,
W82-01730 4D

Sustaining the Growth of Provence.
W82-01738 6D

Wanted: Water for Development,
W82-02088 6D

WATER TABLE
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

WATER TANKS
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

WATER TREATMENT
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

Cape Town Waterworks Service Reservoirs: Plattekloff (1974) and Tygerberg (1964).
W82-01747 8A

A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

Tying Up TCE,
W82-01866 5G

Tackling the Nitrate Problem.
W82-01874 5F

WATER USE
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

WATER USERS
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

WATER VAPOR
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

WATERSHED MANAGEMENT
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

WATERSHED MODELS
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

WATERSHEDS
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Transport of Salts in Catchments and Soils,
W82-01880 2G

WAVE ACTION
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

WEATHER PATTERNS
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

WELL DATA
Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

WELLS
Groundwater Levels in Nebraska 1980,
W82-01785 2F

WESER RIVER
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

WETLANDS
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

WHEAT
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

WHISKEY DISTILLERY WASTEWATER
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

WILD RIVERS
Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

WILDLIFE
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

WIND-DRIVEN CURRENTS
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

WIRE INDUSTRY
Pollution Solutions--The Wire Drawing Industry.
W82-02041 5D

WOOD
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

WOOD WASTES
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

WYOMING
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

YELLOW RIVER BASIN
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

ZETA POTENTIAL
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

ZINC
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

ZOOPLANKTON
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

AUTHOR INDEX

ABEL, P. D.
A New Method for Assessing the Lethal Impact of Short-Term, High-Level Discharges of Pollutants on Aquatic Animals,
W82-01993 5C

ABRAHAM, M.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

ABT, S. R.
Evaluating Scour at Culvert Outlets,
W82-01934 4D

AHMED, Q. S.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

AHUJA, L. R.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

AIKEN, J. D.
The National Water Policy Review and Western Water Rights Law Reform: An Overview,
W82-01659 6E

ALEXANDER, W. J.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

ALHONEN-HONGISTO, L.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

ALLANSON, B. R.
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

ALLEN, C. P.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

ALLEN, G. H.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

ALLEN, K. O.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

ALLEN, L. H. JR.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

ALLEN, M. P.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

ALLEN, N. L.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

ALMBERG, L.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

ALSEN, C.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

ALTHER, G. R.
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

AMOROS, C.
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

ANDERSON, D.
Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

AOYAMA, M.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

APONASENKO, A. D.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

APPLETON, A. R. JR.
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

ARAKEL, A. V.
Geochemistry and Hydrodynamics in the Hutt and Leeman Evaporitic Lagoons, Western Australia: A Comparative Study,
W82-01746 2L

ARENS, H-J.
Structural Aspects of the Water Supply in the Federal Republic of Germany,
W82-02066 6E

ARMITAGE, P. D.
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

ARNOLD, M. D.
Floodplain Management: A Flood and Land Planning System,
W82-01872 6F

ARSLANOVA, T. P.
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

ARTHER, R. G.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

ASPILA, K. I.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

ASTON, S. R.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

AUSTIN, B.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

AVADHANULU, R. V.
An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

BABENKO, I. A.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

BAETJER, K.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

BAGNYUK, L. I.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

BAIN, G. L.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

BAKER, J. P.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

BALARAJU, M.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

BALE, J. B.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

BANDY, J. T.
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

BANNINK, B. A.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

BARBEAU, C.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

BARDSLEY, W. E.
Note on Random Raindrops and Sampling Error,
W82-02032 2B

Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

BARKER, T. W.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

BARON, D. M.
Screened Auger Aids Investigation,
W82-02096 7B

BARROW, G. I.
Microbial Pollution of Coasts and Estuaries: The Public Health Implications,
W82-02051 5C

BATHURST, E. T. J.
Bromide in Canterbury Ground Water,
W82-02056 5B

BATTAN, L. J.
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

BATTERMAN, A. R.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

BEAR, J.
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

BEAUCHAMP, J. J.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

BEAVIS, B.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

BEDNAR, G. A.
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

BEECH, J. A.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

BELOBABA, E. G.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

BENGTSON, R. L.
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

BENGTSSON, L.
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

BENNDORF, J.
A Control Mechanism of the Phytoplankton Respiration in a Eutrophic Reservoir,
W82-02030 2H

BENOIT, F. M.
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

BERKES, F.
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

BEUKES, D. J.
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

BHAN, S.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

BHATTACHARYA, S.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

BIGGS, R. B.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

BISCHOF, R. B.
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

BISHOP, A. A.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

BISOGNI, J. J. JR.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

BJERVE, L.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

BLENK, J. B.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

BLOCK, J. C.
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

BLOKHINA, N. P.
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

BLOMQUIST, G.
Water Quality and the Demand for Recreation,
W82-01942 6D

BLOTNICK, J. R.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

BLUMM, M. C.
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

BOLES, K. E.
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

BONACCI, O.
Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

BONELLI, J. E.
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

BORDOVSKY, J. P.
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

BORGMANN, U.
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

BORMAN, R. G.
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

BORROWS, P.
Reviving the Rio Reconquista,
W82-02014 5G

BOTHA, B. J. V.
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

BOUGIE, R.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

BOURBONNIERE, R. A.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

BOWERS, J. A.
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

BOYLE, T. P.
Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

BRADDOCK, R. D.
Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

BRADEN, J. B.
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

BRADFORD, W. L.
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

BRALTS, V. F.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

BRANICA, M.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

BRAS, R. L.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

BRESLER, E.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

BRIGGS, R.
Where Do We Go from Here.
W82-02086 7A

BRIZ-KISHORE, B. H.
An Aquifer Simulation Program for Micro-Based Processors,
W82-01879 2F

BROCK, T. D.
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

BROMLEY, D. W.
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

BROSSET, C.
The Mercury Cycle,
W82-01869 5B

BROWER, W. W. II.
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

BROWN, H. S.
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

BROWN, J. A. H.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

BRYSON, A. W.
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

BUCHAN, R. M.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

BUDAGOVSKII, A. I.
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

BUDWEG, F. M. G.
Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

BULL, D. L.
Environmental Fate of Methyl Eugenol,
W82-02013 5B

BURESH, R. J.
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

BURGER, J. S.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

BURNHAM, L. N.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

BURNS, C. W.
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

BUTTON, D. K.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

CANALE, R. P.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

CARLSON, T. W.
Contourites in Lake Superior,
W82-01935 2H

CASTEIGNAU, G.
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

CASTLE, R. O.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

CETINKAYA, M.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

CHAKRABARTI, C.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

CHALMERS, D. J.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

CHAM, V.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water,
W82-01854 5A

CHANUT, J. P.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

CHAPMAN, M. A.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

CHAPRA, S. C.
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

CHARBONNEAU, J. O. G.
Glacier Surveys in Alberta - 1979,
W82-01855 2C

CHATTOPADHYAY, G. N.
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

CHEN, R. L.
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

CHEN, Y. H.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

CHERKAUER, D. S.
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

CHERNITSKAYA, L. N.
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

CHEUNG, L. S.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

CHHONKAR, P. K.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

CHIU, A. A.
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

CHONG, S. K.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

CHRISTENSEN, E. R.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

CHRISTMAS, A. D.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

CHRISTY, M. S.
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

CHU, S. Y.
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

CHYNOWETH, D. P.
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

CLAIBORNE, M.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

CLARK, B. D.
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

CLARK, M. M.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

CLARK, R. N.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

CLARKE, W. B.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

CLEMMENS, A. J.
Development of Solutions for Level-Basin Design,
W82-01976 3F

CLYMA, W.
Optimal Design of Border Irrigation Systems,
W82-01977 3F

COBLE, L. W. JR.
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

CODNER, G. P.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

COLEMAN, G. A.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

COLWELL, R. R.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

CONLEY, C. D.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

COOK, P. M.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

CORAPCIOGLU, M. Y.
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

CORCORAN, E. F.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

CORDOVA, J. R.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

COTE, J-E.
Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

COULTER, J. B.
The Hazards of Hazardous Waste Management,
W82-01940 6E

COX, R. G.
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

CRABTREE, R. J.
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

CRAIG, K. S.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

CRAUN, G. F.
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

CRIPE, C. R.
Apparatus to Produce Tidal Fluctuations in a Simulated Salt Marsh System,
W82-01930 2L

CRISP, R.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

CROLEY, T. E.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

CRONIN, L. E.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

CROWLEY, P.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

CUMMANS, J. E.
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

CURRY, R. W.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

CURTIS, C. R.
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

DABROWSKI, H.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

DAKERS, J. L.
The Sewerage Policy of Thames Water,
W82-02040 6E

DALY, C. J.
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

DARDIS, K. A.
A Mechanistic Model of a Packed-Bed Electrode Cell to Remove Metal Ions from Dilute Effluent Solutions,
W82-02050 5D

DAVANZO, A. C.
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

DAY, J. C.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

DE VOS, C. P.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

DEDRICK, A. R.
Development of Solutions for Level-Basin Design,
W82-01976 3F

DELLEUR, J. W.
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

DELPHIA, L. M.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

DEMERY, P. M.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

DEMONTMOLLIN, F. A.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

DENDY, B. B.
Case Studies of Agricultural Water Conservation,
W82-01667 3F

DENISOVA, A. I.
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

DI PIETRO, N. D.
The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

DIAZ, R.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

DIBBLE, W. E. JR.
Non-Equilibrium Water/Rock Interactions,
W82-01684 1A

DICK, A. C.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

DIDERIKSEN, R. I.
Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

DIERBERG, F. E.
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

DINEHART, R. L.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

DINIA, N.
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

DISHER, J. W.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

DITWILER, C. D.
Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

DOBSON, H. F. H.
Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes,
W82-02004 2H

DOGADINA, T. V.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

DORAS, N.
Various Kinetic Energy Characteristics of Hail-patterns in the Grossversuch IV Experiment,
W82-01732 2B

DOUGLASS, A. R.
A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

DOWNES, M. T.
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

DOWNS, C. E.
The Technology Transfer Process in Water Resources R&D Management,
W82-01694 6A

DRABBE, J. A.
Electronic Measurement and Recording of Evaporation Loss,
W82-01602 7B

DRAKE, R. A. R.
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

DRAKE, S. R.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

DRESSCHER, TH. G. N.
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

DRISCOLL, C. T. JR.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

DUBKO, N. V.
Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

DUESZELN, J.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

DUKE, W.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

DUNCAN, J. M.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

DZHAMALOV, R. G.
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

DZHOGAN, L. YA.
Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

EAGLE, G. A.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

ECCLES, P. G.
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

EL-SABH, M.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

ELDER, V. A.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

ELLIS, J. B.
Water Quality Indices: An Additional Management Tool,
W82-01994 5G

ELWOOD, J. W.
Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers,
W82-01941 5B

EMMETT, R. C.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

ENGLUND, J-O.
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

ENGMAN, E. T.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

ERASMUS, D. A.
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

ERKENBRECHER, C. W. JR.
Sediment Bacterial Indicators in an Urban Shellfishing Substuary of the Lower Chesapeake Bay,
W82-01661 5A

ESCALONA, R. L.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

ESTEP, M. F.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

EVANS, G. T.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

EVANS, J. C. W.
Century-Old Board Mill Operates with Zero Effluent Discharge,
W82-01626 5D

EVANS, J. E.
Contourites in Lake Superior,
W82-01935 2H

FACI, J. M.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

FAHRENTHOLD, P. D.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

FALKOWSKI, P. G.
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

FAPOHUNDA, H. O.
River Basin Sequential Water Use and Salinity Effects on Crop Yield Economics,
W82-01671 3F

FERERES, E.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

FERRARA, R. A.
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

FIFIELD, J. S.
Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

FILATOV, N. N.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

FINDLAY, D. M.
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

FINLAYSON, B. J.
Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

FINNEY, B. A.
Random Differential Equations in Water Quality Modeling,
W82-01688 6A

FISHELSON, G.
Water Quality and the Demand for Recreation,
W82-01942 6D

FITZGERALD, P. R.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

FLECKSEDER, H.
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

FLEROV, B. A.
The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

FLINT, E. A.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

FLOOD, R. D.
Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

FLORESTANO, P. S.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

FODA, M.
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

FODOR-CSANYI, P.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

FORSYTH, D. J.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

FOSTER, G. R.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

FOSTER, I. D. L.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

FOSTER, K. E.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

FOX, J. C.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

FRANCKO, D. A.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

FRANK, N. A.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

FRANKLIN, A. G.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

FRANZIN, W. G.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

FRASER, A. S.
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

FREEMAN, D. H.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

FREEMAN, L.
The Day That the Rain Came Down,
W82-02064 2E

FRENCH, C. O.
Gulf of Mexico: A Socioeconomic View of Competing Resources,
W82-01901 6B

FREVERT, T.
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

FRITTON, D. D.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

FROEHLICH, D. C.
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

FURUTANI, A.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

GAGE, J.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

GALAGAN, N. P.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

GASS, T.
Applications of Aerial Photography,
W82-01988 7B

GAVIN, J.
Summer Ice and Carbon Dioxide,
W82-01843 2C

GAVRISHOVA, N. A.
Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

GERHART, J. M.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

GERHOLD, R.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

GHILDYAL, B. P.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

GIANQUINTA, A. R.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

GIAQUINTA, A. R.
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

GILBERTSON, C. B.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

GILLILAND, M. W.
The Lake Tahoe Basin: A Systems Analysis of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

GITLIN, H. M.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

GLOVER, E. W. JR.
Role of the Geotechnical Consultant in Siting Suitable Areas for Hazardous Waste Disposal,
W82-01636 5E

GOGGINS, C.
Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

GOLD, R. L.
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

GOLDSCHMIDT, E. E.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

GONZALES-VILLARREAL, F. J.
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

GONZALEZ, V. J. B.
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

GOODE, S. R.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

GOPPERS, V. M.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

GOROBETS, L. V.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

GOTTLIEB, L.
Development and Applications of a Runoff Model for Snowcovered and Glacierized Basins,
W82-01885 2C

GOULD, M. S.
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

GRABOW, W. O. K.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

GRANTZ, A.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

GRAY, N. F.
Simple Retention Time Analysis in Trickling Filters Using Conductivity,
W82-01876 5D

GREEN, A.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

GREEN, M.
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

GREEN, R. E.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

GREENBERG, M. R.
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

GREESON, P. E.
Infectious Waterborne Diseases,
W82-01784 5A

GRIEVE, I. C.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

GRIFFIN, A. H.
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

GRISAK, G. E.
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

GROTERUD, O.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams,
W82-01891 7B

GRUSHKO, YA. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

GUNNER, H. B.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

GUPTA, S. C.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

HADALA, P. F.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

HAGERHALL, B.
International Cooperation to Protect the Baltic,
W82-02087 6E

HAGLUND, P.
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

HAINES, T. A.
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

HALL, D. K.
Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

HAMBLIN, A. P.
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

HAMMOND, D. E.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

HANKS, R. J.
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

HANSEN, P.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

HARDY, J. W.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

HARGREAVES, G. H.
Simplified Method for Rainfall Intensities,
W82-01978 2B

Water Requirements and Man-Induced Climate Change,
W82-01633 2D

HARLEMAN, D. R. F.
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

HARRINGTON, W.
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

HARRISON, P.
Wanted: Water for Development,
W82-02088 6D

HASSAN, A. A.
Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

HAYDEN, T.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

HEANEY, J. P.
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

HEATH, M.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

HEATH, R. T.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

HEATON, T. H. E.
Excess Air in Groundwater,
W82-02099 2F

HECKER, G. M.
Coherence Between Wind and Current Events in a Nearshore, Shallow Water, Wave Dominated Environment,
W82-01674 2L

HEDGEPETH, J.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

HENDERSON-SELLERS, B.
Destratification and Reaeration as Tools for In-Lake Management,
W82-01648 5G

HENNART, J. P.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

HENNESSY, R. R.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

HENNIG, H. F-K. O.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

HENRY, J. R.
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

HERBAUTS, J.
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

HERGENRADER, G. L.
Eutrophication of the Salt Valley Reservoirs, 1968-73. I. The Effects of Eutrophication on Standing Crop and Composition of Phytoplankton,
W82-01653 5C

Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

HERRERA, I.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

HERRINGTON, P. R.
Charging Policies for Water Services,
W82-01734 6C

HILEMAN, B.
Acid Precipitation,
W82-01607 5C

HILNER, C. A.
Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water,
W82-01812 5A

HINDE, R. C.
Streamlined Regulations Could Help Make New Stormwater Management Concepts Part of the Tradition,
W82-02000 4A

HINKINS, S. M.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

HINRICHSEN, D.
Poland: Coming to Grips with Pollution,
W82-02092 5G

HITES, R. A.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

HO, J.
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

HO, KC.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

HOBO, T.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

HODGKISS, I. J.
Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

HOLBECHE, J. D.
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

HOLMES, N. T. H.
Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

HOLT, R. F.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

HORVATH, G. L.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

HOUSE, M.
Water Quality Indices: An Additional Management Tool,
W82-01994 5G

HOWARD, P. M.
Impressions of Soil and Water Conservation in China,
W82-01730 4D

HOWARD-WILLIAMS, C.
Phosphorus Cycling in a Dense Potamogeton Pectinatus L. Bed,
W82-02070 2H

HOY, N. D.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

HRUBOVACK, J. M.
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

HUBER, W. C.
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

HUCKINS, J. N.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

HUMPHRIES, C.
Recording Underground,
W82-02036 8A

HUNKINS, K.
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

HUSSONG, D.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

HUTCHINSON, C. B.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

IL'CHENKO, N. I.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

INKINA, G. A.
Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

INOUE, Y.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

ISAACSON, P. A.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

ISAKOVA, YE. F.
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

IVAKHNENKO, A. G.
The Modeling of Aquatic Ecological Systems,
W82-01972 5B

JACKSON, T. J.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

JACOBSON, J. S.
Acid Rain and Environmental Policy,
W82-01987 5B

JAMES, W.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

JAMIESON, A.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

JANA, P. K.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

JANISZEWSKI, M.
Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

JENKINS, J. J.
Terrain, Groundwater and Secondary Salinity in Victoria, Australia,
W82-02046 2F

JENNINGS, M.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

JESSEN, S.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

JOB, S. V.
Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

JOBLING, M.
Temperature Tolerance and the Final Preferendum - Rapid Methods for the Assessment of Optimum Growth Temperatures,
W82-01996 5C

JOHNSON, B. T.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

JOHNSON, D. M.
Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

JOHNSON, D. W.
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain,
W82-01867 5B

JOHNSON, M. S.
Groundwater Levels in Nebraska 1980,
W82-01785 2F

JOHNSON, T. C.
Contourites in Lake Superior,
W82-01935 2H

JOHNSTON, S. A. JR.
Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

JOLLY, V. H.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

JONES, J. G.
The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

JONES, J. R.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

JORDAN, T. F.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

JORET, J. C.
Survival of Enteroviruses Adsorbed on Glass Microfibers During Postal Transport (Survie de Virus Enteriques Adsorbes sur Microfibre de Verre au Cours d'un Transport Postal),
W82-01637 5A

JOSEPHSON, J.
Protecting Virginia's Waterways,
W82-01608 5G

JUO, A. S. R.
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

JURY, W. A.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

KAERGAARD, H.
Drawdowns at the Free Water Table During Pumping Tests in Artesian and Semiartesian Aquifers,
W82-01890 2F

KALFF, J.
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

KALMAR, D.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

KANNAN, V.
Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

KAO, J-F.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

KASIDA, Y.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

KASSO, W. B.
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

KAVVAS, M. L.
A Stochastic Cluster Model of Daily Rainfall Sequences,
W82-01651 2B

KEENE, K. M.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

KELLER, V. W.
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

KELLER, W.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

KELLY, C. A.
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

KHARITONOVA, N. N.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

KIBLER, D. F.
Legal Challenge of the Ungaged Watershed,
W82-01664 2E

KING, J. W.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

KINNERSLEY, D.
Charging for Water Supply in England and Wales in the 1980s,
W82-01722 6C

KINNEY, W. C.
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

KIRCHER, J. E.
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

KITE, G. W.
Recent Changes in Level of Lake Victoria,
W82-01711 4A

KITITSYNA, L. A.
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

KLAPPER, H.
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

KLEINSTREUER, C.
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

KLEPPER, R. P.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

KNAEBEL, K. S.
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

KNIGHT, J. H.
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

KNOTT, J. M.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

KOEHLER, J. H.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

KONDO, K.
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

KOVAL'CHUK, A. A.
Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

KOZHOVA, O. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

KRASOVSKY, G. N.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

KRISHNAMOORTHI, K. P.
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

KRUPNICK, A. J.
Stationary Source Pollution Policy and Choices for Reform,
W82-01847 6E

KRUSE, H.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

KRYLOVA, E. V.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

KUDRYAVTSEV, V. M.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

KUKLA, G.
Summer Ice and Carbon Dioxide,
W82-01843 2C

KUMAR, A.
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

KUUSISTO, E.
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

KUZNETSOVA, M. A.
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

KWOK, TT.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

LABUTINA, T. M.
The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

LAFLEN, J. M.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

LAHAV, E.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

LAHL, U.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

LAIRD, C. E.
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

LAM, C. W. Y.
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

LANE, A. G.
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

LANE, L. J.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

LAPKINA, L. N.
The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

LARSON, W. E.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

LASKOWSKI-HOKE, R. A.
Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

LAW, R. J.
Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

LAYLA, R. I.
Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

LEACH, J. H.
Comparative Limnology of Inner Long Point Bay, Lake Erie, and Adjacent Waters of the Outer Bay,
W82-02005 5B

LEADBETTER, M. R.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

LEBEL, G. L.
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

LECKIE, J. O.
Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

LEE, G. F.
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

LEENTVAAR, J.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

LEGRAND, H. E.
Perspective on Management and Disposal of Hazardous Wastes,
W82-01635 5E

LEMLIN, J. S.
The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

LEMON, D.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

LEMON, E.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

LENOVA, L. I.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

LEONI, V.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

LESSIG, D. C.
Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication,
W82-01797 5C

LEVINGS, G. W.
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

LIEDY, R. B.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

LINDSTROM, K. P.
Case Studies of Agricultural Water Conservation,
W82-01667 3F

LINDSTROM, M. J.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

LINK, A. N.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

LISLE, I. G.
Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

LITVINOV, N. N.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

LOGAN, B. E.
Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

LOPEZ-AVILA, V.
Oxidation of Phenolic Antioxidants in a River System,
W82-01801 5B

LORAH, W. L.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

LOUCKS, D. P.
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

LOWE, D. R.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

LYLE, W. M.
Low Energy Precision Application (LEPA) Irrigation System,
W82-01859 3F

MACCUBBIN, A. E.
Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

MACKO, C. A.
The Removal of Organic Matter from Surface Water Supplies by Anion Exchange Resins,
W82-01697 5F

MACPHERSON, J. M.
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

MADES, D. M.
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

MAHADEVAN, A.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MAHAN, M. O.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

MAIOLO, J. R.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

MAITY, S. P.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

MAKONNEN, G. A.
Double and Monocropped Wheat and Grain Sorghum Under Different Tillage and Row Spacings,
W82-01862 2I

MALLORY, M. J.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

MALONEY, L. M.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

MAMONTOVA, L. M.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

MANDAL, L. N.
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

MANDELLI, E. F.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

MANTELL, A.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

MARA, D. D.
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

MARCHANT, R.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

MARCUS, M. D.
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

MARCUSON, W. F. III
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

MARSH, D. G.
Reverse Phase Concentration of Trace Polycyclic Aromatic Hydrocarbons in Water,
W82-01689 5A

MARTINEC, J.
Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

MASCARENHAS, A. C.
Remote Sensing in Development,
W82-01719 7B

MATTHEWS, R. J.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

MATVIYENKO, A. M.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

MCCALLUM, I. D.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

MCCARTY, P. L.
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

MCDOWELL, T. R.
Geographic Variations in Water Quality and Recreational Use Along the Upper Wallowa River and Selected Tributaries,
W82-01681 5A

MCDUFF, R. E.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

MCFARLANE, G. A.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

MCKAY, G.
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

MCKEE, P.
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

MCKELLAR, H. N. JR.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

MCLEAN, R. A. N.
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

MCMAHON, T. A.
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

MEDINA, M. A. JR.
Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

MEIER, R.
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

MELVIN, W. W.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

MENSAH, E. K.
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

MESHCHERYAKOVA, R. I.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

MEYER, E. R.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

MEYER, K. F.
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway,
W82-01748 2F

MEYERS, P. A.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

MEZEIX, J. F.
Various Kinetic Energy Characteristics of Hail-patterns in the Grossversuch IV Experiment,
W82-01732 2B

MIDDLEBROOKS, E. J.
The Flowering of Wastewater Treatment,
W82-02015 5D

MIETTINEN, J. K.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

MILLER, D. G. JR.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

MILLER, S.
Drinking Water and Its Treatment: An Interview with Professor Sontheimer,
W82-01728 5F

MILLER, T. S.
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

MISTRY, P. D.
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

MITCHELL, P. D.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

MITCHELL, S. F.
Phytoplankton Photosynthesis and Its Relation to Standing Crop and Nutrients in Two Warm-Monomictic South Island Lakes,
W82-01700 2H

MOLOF, A. H.
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

MONDADA, G.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

MONSELISE, S. P.
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

MOODY, J. L.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

MOOK, W. G.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

MOREL, F. M. M.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

MOREL-SEYTOUX, H. J.
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

MORGAN, J. J.
Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

MORGAN, M. D.
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

MORGAN, S. L.
Characterization of an Enzymatic Determination of Arsenic(V) Based on Response Surface Methodology,
W82-01656 5A

MORRIS, W. T.
Perseverance Produces County Park,
W82-01932 6D

MORRISSON, N. J. III.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes,
W82-01931 5C

MOSELHY, M. M.
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

MOTT, T. D.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

MOUAT, D. A.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

MROZED JR, E.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel,
W82-01813 5B

MUMALLAH, N. A.
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

MUMALLAH, N. A. K.
Water Purification Studies with Activated Carbon and Foam Flotation,
W82-01692 5D

MUTHUKUMAR, G.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MYHRSTAD, J. A.
Groundwater Chemistry of Some Selected Areas in Southeaster Norway,
W82-02020 2K

NAEF, F.
Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

NAIR, G. B.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

NAKASHIO, F.
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

NATARAJAN, R.
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

NEBRAT, A. A.
Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

NELSON, J. G.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

NICKS, A. D.
Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

NOWLIN, J. D.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

NURNBERG, H. W.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

NWA, E. U.
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

NYBORG, M.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

NYE, J. C.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

O'NEILL, P.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

O'NEILL, W. B.
Pollution Permits and Markets for Water Quality,
W82-01699 6A

OFFICER, C. B.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

OKSIYUK, O. P.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

OLEYNIK, G. N.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

OLIVIER, R. J.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

OMORINBOLA, E. O.
Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

ONISHI, Y.
Sediment-Contaminant Transport Model,
W82-01614 5B

ONSTAD, C. A.
Crop Residue Removal and Tillage; Effects on Soil Erosion and Nutrient Loss in the Corn Belt,
W82-01770 2J

ORAGUI, J. I.
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

ORCUTT, J. D. JR.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

ORDAZ, C.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

OREMLAND, R. S.
Denitrification Associated With Periphyton Communities,
W82-01814 5B

ORREN, M. J.
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex,
W82-01969 5A

OUTEN, R. B.
The National Commission on Water Quality: A Case Study in Congressional Policy Analysis,
W82-01669 6B

PACE, M. L.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

PAGE, G. W.
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

PAGE, G. W. III.
Toxic Substances in Water: Patterns of Contamination and Policy Implications,
W82-01695 5A

PAGE, H. R. S.
Developments in Instrumentation and Automation in Sewage Treatment,
W82-02043 5D

PALOMEQUE, B.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

PANDOZZI, J.
Rearing Pacific Salmon in Saltwater Ponds Fertilized with Domestic Wastewater, Data Report, June 1979 - May 1980,
W82-01906 3C

PANICKER, P. V. R. C.
Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons,
W82-01733 5D

PANKOW, J. F.
Kinetics for the Aquatic Environment,
W82-01631 2K

PANKOW, J. R.
Kinetics for the Aquatic Environment,
W82-01806 2K

PARKER, J. G.
Effects of Pollution Upon the Benthos of Belfast Lough,
W82-02059 5C

PARKIN, T. B.
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

PARLANGE, J. Y.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

PATEL, K. R.
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

PATRICK, P. H.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

PATRICK, W. H. JR.
Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

PAUL, C. K.
Remote Sensing in Development,
W82-01719 7B

PAWLIKOWSKI, W.
Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

PEDERSEN, D.
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

PEDERSON, D. T.
Groundwater Levels in Nebraska 1980,
W82-01785 2F

PENG, T-H.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

PETERSEN, G. W.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

PHILLIPS, G. R.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

PHILLIPS, R. E.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

PIALY, P. P.
Mixing Zone Analysis for River Plumes,
W82-01961 5B

PICKENS, J. F.
Scale-Dependent Dispersion in a Stratified Granular Aquifer,
W82-01986 2F

PLAUMANN, K. W.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

PLEYSIER, J. L.
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

POOLE, G. J.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

POOTS, V. J. P.
Kinetics and Diffusion Processes in Colour Removal from Effluent Using Wood as an Adsorbent,
W82-02047 5D

POTAPOVA, N. A.
Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

POTGIETER, H. J.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

POWERS, W. F.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

PRAKASH, A.
Statistical Determination of Design Low Flows,
W82-01858 2E

PRATER, B. L.
Dredged Material Evaluations: Correlations Between Chemical and Biological Evaluation Procedures,
W82-01985 5C

PRIOR, B. A.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

PROCTOR, B. L.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

PROEBSTING, E. L. JR.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

PUCCETTI, G.
PCB and HCB in the Sediments and Waters of the Tiber Estuary,
W82-02057 2L

PUGH, C. A.
Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

QUINN, J. P.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei,
W82-01750 5C

RADCLIFFE, D.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

RADFORD, P. J.
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

RAHI, G. S.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

RAI, S. D.
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

RAJPUT, R. K.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

RAM, V.
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

RAO, D. B.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

RASHID, H. A-H.
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

RASPOR, B.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

RATHBUN, P. A.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

RATHFELDER, E. L.
The Effect of Different Water Regimes on Plant Growth and Nodule Structure of Greenhouse-Grown Winged Bean (Psophocarpus Tetragonolobus),
W82-01723 2I

RATHORE, T. R.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

RATUSHNAYA, M. YA.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

RAUCHER, R. L.
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

REA, D. K.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

REDDY, J. M.
Optimal Design of Border Irrigation Systems,
W82-01977 3F

REED, S. C.
The Flowering of Wastewater Treatment,
W82-02015 5D

REES, J. F.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

REID, I. A.
Glacier Surveys in Alberta - 1979,
W82-01855 2C

REMENYAK, M. B.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

REMFRY, J. E.
Centrifugal Dewatering,
W82-01912 5E

RETTA, A.
Corn and Alfalfa Production as Influenced by Limited Irrigation,
W82-01945 3F

RHO, J.
Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

RIBENY, F. M. J.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

RIDKER, R. G.
Long-Run Effects of Environmental Regulation,
W82-01848 6A

RIGGINS, R. E.
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

RIHA, S. J.
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

RIPPON, J. W.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

RITTER, J. R.
Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

RITTMANN, B. E.
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

RJANZHIN, S. V.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

ROBERTSON, B. R.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

ROBINSON, A. R.
Erosion and Sediment Control in China's Yellow River Basin,
W82-01729 4D

ROMANENKO, V. D.
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

ROSALES, M. T. L.
On the Presence of Fecal Steroids in Sediments from Two Mexican Harbors,
W82-02012 5A

ROSE, B.
Managing Water at Helicopter Plant,
W82-01974 5D

ROSE, C. W.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

ROSSMANN, R.
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

ROWLEY, C. K.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary,
W82-02060 2L

RUDD, J. W.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

RUFF, J. F.
Evaluating Scour at Culvert Outlets,
W82-01934 4D

RUNNELLS, D. D.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

RUNNING, S. W.
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

RUSHTON, K. R.
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

RUSSELL, R. B.
Learning from the Skipton Flood,
W82-02063 2E

RUSSO, D.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

RUSSO, R. C.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

RYDIN, S.
Control of Bark Landfill Leachates with an Anaerobic Treatment System,
W82-02006 5D

RYDZEWSKI, J. R.
Optimization of Water Resources for Irrigation in East Jordan,
W82-01742 6A

RYTHER, J. H.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

RZOSKA, J.
Environmental Studies: Their Implications and the Special Case of Egypt,
W82-02062 6G

SACHAN, R. S.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

SALOMONS, W.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

SANDER, G.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

SAVAGE, J. C.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

SAVVINA, O. V.
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

SAWAR, S.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

SAX, R. I.
Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli,
W82-01968 2B

SAYLER, G. S.
Methanogenesis in Freshwater Sediments: Inherent Variability and Effects of Environmental Contaminants,
W82-01825 5C

SAYRE, W. G.
Selenium: A Water Pollutant from Flue Gas Desulfurization,
W82-01960 5B

SCAVIA, D.
Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron,
W82-01917 2H

SCHALEKAMP, M.
Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

SCHMUGGE, T. J.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

Soil Moisture Updating and Microwave Remote Sensing for Hydrological Simulation,
W82-01611 2G

SCHOFIELD, C. L.
Effect of Aluminum Speciation on Fish in Dilute Acidified Waters,
W82-01663 5C

SCHREIER, H.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

SCHROEDER, S. H.
Pollution Control: Changing Approaches,
W82-01870 6E

SCHWAB, D. J.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario,
W82-01616 2H

SCHWARZENBACH, R. P.
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

SCOTT, F. A.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

SELBY, K.
Waste Disposal--Choosing and Licensing Site,
W82-02035 5G

SEN, H.
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

SHAPIRO, H. M.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

SHARMA, B. M.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

SHARMA, H. C.
Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

SHAVER, T. N.
Environmental Fate of Methyl Eugenol,
W82-02013 5B

SHAW, T. L.
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

SHCHUR, L. A.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

SHELEF, G.
Step Fed Plug Flow Reactor for Biological Wastewater Treatment Versus Continuous Flow Stirred Tank Reactor (CFSTR),
W82-01618 5D

SHERRARD, J. H.
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

SHERTON, C. C.
Preserving Instream Flows in Oregon's Rivers and Streams,
W82-01871 6E

SHIH, S. F.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

Upland Marsh for Water Quality Control,
W82-01962 5B

SHIKLOMANOV, I. A.
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

SHIROKOV, V. A.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

SHMAKOV, V. M.
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

SHUSTOV, YU. A.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

SIBONY, J.
Disinfection of Drinking Water in Developing Countries,
W82-02091 5F

SID'KO, F. YA.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

SIMARD, R. G.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

SIMMONS, J. D.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

SIMONS, D. B.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

SINAI, G.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

SINCLAIR, M.
Phytoplankton Distributions Observed During a 3 1/2 Days Fixed-Station in the Lower St. Lawrence Estuary,
W82-01938 2L

SINGER, R. D.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

SINGH, S.
Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

SINGH, S. N.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

SINGHAL, A. E.
Tying Up TCE,
W82-01866 5G

SINHA, D. S.
The Chambal Project: Problems and Solutions,
W82-01739 4A

SKAAR, D. R.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

SLACK, R.
Aircraft Remote Sensing of Soil Moisture and Hydrologic Parameters, Taylor Creek, Fla., and Litle River, Ga., 1979 Data Report,
W82-01771 7B

SLAVENS, D. R.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

SMIRNOVA, N. N.
Ecological and Physiological Features of the Root System of Inshore Hydrophytes,
W82-01715 5B

SMITH, C. J.
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

SMITH, F. B.
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

SMITH, R. J.
Acid Rain Agreement,
W82-01933 5B

SMOLEN, M. D.
Nutrient Runoff from Agricultural and Non-Agricultural Watersheds,
W82-01662 5B

SOKOL'SKIY, A. F.
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

SONG, C. C. S.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

SONNEN, M. B.
Case Studies of Agricultural Water Conservation,
W82-01667 3F

SOROOSHIAN, S.
Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

SPIRA, W. M.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

SPOSITO, G.
The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

SRIKANTHAN, R.
Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

STACHEL, B.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

STANLEY, C. W.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

STANNERS, D. A.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

STAVSKAYA, S. S.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

STOL'BERG, F. B.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

STOLLENWERK, K. G.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

STOLZY, L. H.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

STORTZ, K. R.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

STRATHMANN, H.
Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

STRAUB, C. P.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

STRELKOFF, T.
Development of Solutions for Level-Basin Design,
W82-01976 3F

STUDNICKI, M.
Determination of Germanium, Vanadium, and Titanium by Carbon Furnace Atomic Absorption Spectrometry,
W82-01836 5A

SUCHER, J.
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

SUJARITTANONTA, S.
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

SUMMERS, J. K.
A Sensitivity Analysis of an Ecosystem Model of Estuarine Carbon Flow,
W82-01875 2L

SUZUKI, S.
Ion Flotation-Spectrophotometric Determination of Traces of Chromium (VI),
W82-02007 5A

SWANK, W. T.
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

SWANSON, N. P.
Controlling Runoff for Livestock Feedlots; A State of the Art,
W82-01769 5G

SWIFT, L. W. JR.
Long Term Responses of Streamflow Following Clearcutting and Regrowth,
W82-01610 4C

SYDOR, M.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

TAKALA, S.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

TAKAMA, N.
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

TAKASE, K.
Integrated Agricultural Development in the Philippines,
W82-01725 6B

TALSMA, T.
Transport of Salts in Catchments and Soils,
W82-01880 2G

TANAKA, K.
Measurement of Heavy Water Concentration with a Density Meter,
W82-02009 5A

TARAPCHAK, S. J.
Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water,
W82-01824 2H

TAYLOR, B. F.
Potential for Biodegradation of Phthalic Acid Esters in Marine Regions,
W82-01829 5B

TAYLOR, F. J. R.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

TAYLOR, J.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water,
W82-01853 5A

TEED, J. C.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

TENNANT, D.
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

THAYER, G. W.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

THINGVOLD, D. A.
Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

THOMPSON, G. B.
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

THOMPSON, J. B.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

THOMSEN, A. G.
Spatial Simulation of Snow Processes,
W82-01887 2C

THOMSEN, T.
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

THOMSON, L. J.
Bromide in Canterbury Ground Water,
W82-02056 5B

THURSTON, R. V.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

TIMERKAYEVA, A. N.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

TOMLINSON, L. M.
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

TORDIFFE, E. A. W.
The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

TORGERSEN, T.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

TOWNS, D. R.
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

TREADWELL, B. D.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

TRISKA, F. J.
Denitrification Associated With Periphyton Communities,
W82-01814 5B

TRUITT, R. E.
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

TSCHETTER, P.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

TSEYEB, YA. YA.
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

TUCKER, W. G.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

TUFFLEY, R. E.
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

TULEPOVA, G. B.
Formation of Water Quality in the Irtysh-Karaganda Canal,
W82-01716 5B

TURNER, M. A.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

TURNPENNY, A. W. H.
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

TUZHIKHIN, G. G.
Grout Curtain in the Foundation of the Arch Dam of the Inguri Hydroelectric Station,
W82-01973 8A

UHLMANN, D.
Limnology and Performance of Waste Treatment Lagoons,
W82-02026 5D

ULKEN, A.
On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

UNCLES, R. J.
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

USTACH, J. F.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs,
W82-01902 2L

VALENTA, P.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

VALENTIN, P.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

VAN DE KREEKE, J.
Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

VAN DER MARK, H.
Experience with a Simple Method for the Biological Evaluation of Surface Water Quality,
W82-02029 5A

VAN DUIVEDIJK, J.
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

VAN EVERDINGEN, R. O.
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories,
W82-01904 2F

VAN HEEK, L.
Control of Peach Tree Growth and Productivity by Regulated Water Supply, Tree Density, and Summer Pruning,
W82-01883 2I

VAN RENSBURG, J. F. J.
Health Aspects of Organic Substances in South African Waters - Opinions and Realities,
W82-01712 5A

VANDERPLOEG, H. A.
Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston,
W82-01823 7B

VANMARCKE, E. H.
Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

VASIL'YEVA, G. L.
Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

VASIUKOVITCH, L. J.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

VIJAN, P. N.
Simultaneous Determination of Trace Metals in Sewage and Sewage Effluents by Inductively Coupled Argon Plasma Atomic Emission Spectrometry,
W82-01828 5A

VINCENT, W. F.
Nitrate Accumulation in Aerobic Hypolimnia: Relative Importance of Benthic and Planktonic Nitrifiers in an Oligotrophic Lake,
W82-02023 2H

VINIKOUR, W. S.
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

VINK, J. S. L.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

VOGEL, J. C.
Excess Air in Groundwater,
W82-02099 2F

VOROB'YEV, V. I.
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

WALDESTAM, S.
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

WALKER, D. R.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

WALKER, W. R.
Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

WALLEN, D. G.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

WANG, L. K.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

WARD, P. R. B.
Sediment Transport and a Reservoir Situation Formula for Zimbabwe-Rhodesia,
W82-01736 2J

WARSH, C. E.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico,
W82-01903 5E

WATSON, K.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

WATSON, S.
Relationships Between Nannoplankton and Lake Trophic Status,
W82-01640 5C

WATSON, W. D.
Long-Run Effects of Environmental Regulation,
W82-01848 6A

WEBB, M. G.
Charging Policies for Water Services,
W82-01734 6C

Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

WEBER, H. W.
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

WEBER, J. H.
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration,
W82-01632 5F

WEFRING, D. R.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

WEINER, R. M.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

WELBY, C. W.
A Graphical Approach to Prediction of Groundwater Pollutant Movement,
W82-01634 5B

WELLS, M. R.
A Survey of Trihalomethanes in the Drinking Water System of Murjreesboro, Tennessee,
W82-01817 5B

WELSH, F. W.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

WEN, C-G.
Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River,
W82-01995 7B

WESTALL, J.
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

WHEELER, R. P.
Pollution from Farms,
W82-02039 5D

WHITTON, B. A.
Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

WIANCKO, P. M.
Environmental Design and Operation of Nanticoke Thermal Generating Station,
W82-01907 5D

WILKINSON, L. F.
Bromide in Canterbury Ground Water,
W82-02056 5B

WILLIAMS, D. T.
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

WILLIAMS, J.
Anomalies in Temperature and Rainfall During Warm Arctic Seasons as a Guide to the Formulation of Climate Scenarios,
W82-01975 2B

WILLIAMS, R.
Effects of Sedimentation on the Gravels of an Industrial River System,
W82-01881 5C

WILLSON, K. E.
Loading Estimates to Lake Erie, 1967-1976,
W82-01852 5A

WILSON, D. J.
Precipitate Flotation Studies with Monolauryl Phosphate and Monolauryldithiocarbamate,
W82-01863 5D

WILSON, J.
Removal of Organics from Water by Granular Activated Carbon and Microorganisms,
W82-01628 5D

WINNER, J. M.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

WISE, H. E. JR.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

WOLANSKI, E. J.
A Mathematical Model of the Hydrologic Regime of the Upper Nile Basin,
W82-01857 2A

WOLDENBERG, M. J.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

WONG, A.
Toxicity and BOD Effluents Derived from Kraft Pulping of Aged Wood Chips,
W82-01845 5B

WONG, M-H.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

WOODFIELD, R.
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

WOODHOUSE, R. A.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

WRIGHT, K. R.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

WRIGHT, S. G.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

WU, I. P.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

WYETH, R. K.
A Test Utilizing Sediment Traps, Survey Rods, and Radiographs to Monitor Sediment Accumulation from a Dredging Disposal Operation,
W82-01950 7B

YADAV, J. S.
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

YANG, C. T.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

YAPIJAKIS, C.
A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

YATES, R.
Extension of the Integrodifferential Approach to Inhomogeneous Multiaquifer Systems,
W82-02017 2F

YESHOV, YU. V.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

YEVTUSHENKO, N. YU.
Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

YOKSAS, T.
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

YOUNG, R. A.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

ZALL, R. R.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

ZAYCEV, L. V.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

ZEKTSER, I. S.
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

ZHDANOVA, G. A.
A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

ZHOLDAKOVA, Z. I.
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

ZIMNY, H.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

ZUKOWSKA-WIESZCZEK, D.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

ZULLIG, H.
On The Use of Carotenoid Stratigraphy in Lake Sediments for Detecting Past Developments of Phytoplankton,
W82-01706 2H

ZURAWSKI, A.
Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

ZVIBLEMAN, B.
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

ZWAHLEN, F.
Evaluation of a Precipitation Map Using a Smoothed Elevation-Precipitation Relationship and Optimal Estimates (Kriging),
W82-01892 2B

ORGANIZATIONAL INDEX

AGENCY FOR INTERNATIONAL DEVELOPMENT, WASHINGTON, DC.
Remote Sensing in Development,
W82-01719 7B

AGENCY FOR INTERNATIONAL DEVELOPMENT, WASHINGTON, DC. BUREAU FOR AFRICA.
A Water Quality Assessment of Development in the Senegal River Basin,
W82-01740 6G

AGRICULTURAL RESEARCH AND EDUCATION CENTER, LAKE ALFRED, FL.
Upland Marsh for Water Quality Control,
W82-01962 5B

AGRICULTURAL STABILIZATION AND CONSERVATION SERVICE, WASHINGTON, DC.
Agricultural Conservation Program: An Evaluation,
W82-02019 3F

AHMADU BELLO UNIV., ZARIA (NIGERIA). DEPT. OF AGRICULTURAL ENGINEERING.
Using the Bamboo (Bambusa Vulgaris) as Field Drainage Material,
W82-01743 4A

AKADEMIA ROLNICZEJ, WARSAW (POLAND). INST. OF ENVIRONMENTAL PROTECTION.
Plant Biotests in the Bioindication of the Rainfall Pollution in an Oil Refinery Region,
W82-02033 5C

AKADEMIYA NAUK SSSR, BOROK. INST. BIOLOGII VNUTRENNYKH VOD.
Abundance Dynamics of Microorganisms in the Decomposition of Macrophytes,
W82-01999 2H

The Use of Leeches to Identify Pesticides in Water,
W82-02075 5A

AKADEMIYA NAUK SSSR, LENINGRAD. INST. OF LAKE STUDIES.
Investigation of Turbulence and Langmuir Circulation in Lake Ladoga,
W82-02100 2H

AKADEMIYA NAUK SSSR, MOSCOW. INST. VODNYKH PROBLEM.
Groundwater Discharge to the Pacific Ocean,
W82-01647 2F

Ways of Successive Refinement of Methods of Calculating the Duty of Water,
W82-02094 2D

AKADEMIYA NAUK SSSR, NOVOSIBIRSK. INST. FIZIKI.
Phytoplankton Distribution in the Southern and Middle Parts of Lake Baikal,
W82-02078 2H

AKADEMIYA NAUK SSSR, PETROZAVODSK. KARELSKII FILIAL.
Methods of Studying Invertebrate Drift in Rivers,
W82-02074 7A

AKADEMIYA NAUK URSR, KIEV. INST. BOTANIKI.
Effect of Sodium Dodecylsulfate on Unicellular Green Algae of the Genus Chlorella,
W82-01920 5C

AKADEMIYA NAUK URSR, KIEV. INST. HIDOBIOLOGII.
Effect of the Liming of Intensively Exploited Ponds on Phytoplankton Development,
W82-01923 2H

AKADEMIYA NAUK URSR, KIEV. INST. HIDROBIOLOGII.
Biological Pollution and Pollution Control in Canals Diverting Flow from One River Basin to Another,
W82-01922 5C

Biodegradation of Sodium Alkylbenzenesulfonate in Plankton-Containing Pond Water,
W82-01925 5B

A Preliminary Study of the Effect of Pumped-Storage Plant Operation on Zooplankton,
W82-01971 5C

Dynamics of Carp Growth and Biosynthetic Processes in the Liver of the Carp Reared in Containers in Heated Waste Water from Themal Power Stations,
W82-01998 5C

Finds of Relict Infusoria in Kiev Reservoir,
W82-02079 2H

The Predicted Content of Organic and Biogenic Matter in the Water of Vilyuy Reservoir and the Extent to Which It Has Been Confirmed,
W82-02080 2H

Bacterioplankton and Phytoplankton in the Kiev Sector of Kanev Reservoir During the Period of Its Formation,
W82-02081 2H

Planktonic Infusoria of Kiev and Kremenchug Reservoirs,
W82-02082 2H

AKADEMIYA NAUK URSR, KIEV. INST. HIDROLOGII.
Ecological and Physiological Characteristics of Dikerogammarus Haemobaphes in the Areas in Which Heated Water Is Discharged from the Tripol'ye Power Station,
W82-01970 5C

AKADEMIYA NAUK URSR, KIEV. INST. HYDROBIOLOGII.
Hydrologic and Anthropogenic Factors Affecting Water Quality in the Rivers of the Ukrainian Carpathians,
W82-02076 5B

AKADEMIYA NAUK URSR, KIEV. INST. KIBERNETIKI.
The Modeling of Aquatic Ecological Systems,
W82-01972 5B

ALASKA UNIV., FAIRBANKS. INST. OF MARINE SCIENCE.
Dissolved Hydrocarbons and Related Microflora in a Fjordal Seaport: Sources, Sinks, Concentrations, and Kinetics,
W82-01816 5B

ARGONNE NATIONAL LAB., IL.
Biological Consequences of Stream Routing Through a Final-Cut Strip Mine Pit: Benthic Macroinvertebrates,
W82-01948 4A

ARIZONA UNIV., TUCSON. DEPT. OF ECONOMICS.
Water Management in the Colorado River Basin: An Application of Nonlinear Transportation Algorithms,
W82-01677 6A

ARIZONA UNIV., TUCSON. DEPT. OF HYDROLOGY AND WATER RESOURCES.
An Economic and Institutional Assessment of the Water Problem Facing the Tucson Basin,
W82-01698 6B

ARIZONA UNIV., TUCSON. INST. OF ATMOSPHERIC PHYSICS.
Observations of Two Colorado Thunderstorms by Means of a Zenith-Pointing Doppler Radar,
W82-01967 2B

ARIZONA UNIV., TUCSON. OFFICE OF ARID LANDS STUDIES.
The Use of Remote Sensing for an Integrated Inventory of a Semi-Arid Area,
W82-01910 7B

ARMY ENGINEER WATERWAYS EXPERIMENT STATION, VICKSBURG, MS.
Current Methods of Dynamic Analysis for Seismic Stability of Earth Dams,
W82-01953 8D

ASIAN DEVELOPMENT BANK, MANILA (PHILIPPINES). AGRICULTURE AND RURAL DEVELOPMENT DEPT.
Integrated Agricultural Development in the Philippines,
W82-01725 6B

AUBURN UNIV., AL. DEPT. OF ECONOMICS.
Effluent Fees, An Alternative System for Achieving Water Quality: A Case Study,
W82-01665 6F

AUCKLAND REGIONAL AUTHORITY (NEW ZEALAND). WATER LAB.
Acute Toxicity of Increased pH to Freshwater Shrimp Paratya Curvirostris,
W82-01645 5C

AUCKLAND UNIV., (NEW ZEALAND). DEPT. OF BOTANY.
Ecological Studies of Phytoplankton in the Waikato River and Its Catchment,
W82-01704 5C

AUCKLAND UNIV., (NEW ZEALAND). DEPT. OF ZOOLOGY.
Effects of Artificial Shading on Periphyton and Invertebrates in a New Zealand Stream,
W82-01701 5C

AUSTRALIAN NATIONAL UNIV., CANBERRA. RESEARCH SCHOOL OF EARTH SCIENCES.
Fayetteville, Green Lake, New York: 3H-3HE Water Mass Ages and Secondary Chemical Structure,
W82-01838 2H

AYRES, LEWIS, NORRIS AND MAY, INC., ANN ARBOR, MI.
Tying Up TCE,
W82-01866 5G

BANSILAL AMRITLAL COLL. OF AGRICULTURE, ANAND (INDIA).
Effect of Periods of Moisture Availability on Groundnut Crop in the Saurashtra Region of Gujarat,
W82-01708 2G

BATTELLE PACIFIC NORTHWEST LAB., RICHLAND, WA.
Sediment-Contaminant Transport Model,
W82-01614 5B

BAYREUTH UNIV. (GERMANY, F.R.).
Dissolved Oxygen Dependent Phosphorus Release from Profundal Sediments of Lake Constance (Obersee),
W82-02055 2H

BECHTEL, INC., SAN FRANCISCO, CA.
Statistical Determination of Design Low Flows,
W82-01858 2E

BIDHAM CHANDRA KRISHI VISHWA VIDYALAYA, KALYANI (INDIA).
Effect of Soil-Moisture Tensions and Preceding Winter Crops on the Yield and Water-Use Efficiency of Succeeding Crop of Tossa Jute,
W82-02045 2I

BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
Operating Policies for a Surface/Ground Water System,
W82-01741 4B

BREMEN UNIV. (GERMANY, F.R.). DEPT. OF CHEMISTRY.
On Site Continuous Liquid-Liquid Extraction of Nonpolar Organic Compounds in Water,
W82-02008 5A

BRITISH COLUMBIA UNIV., VANCOUVER. DEPT. OF MATHEMATICS.
Phytoplankton Accumulation in Langmuir Cells,
W82-01946 2H

BRITISH METEOROLOGICAL OFFICE, BRACKNELL (ENGLAND).
The Significance of Wet and Dry Synoptic Regions on Long-Range Transport of Pollution and Its Deposition,
W82-01877 5B

BROCK UNIV., ST. CATHARINES (ONTARIO). INST. OF URBAN AND ENVIRONMENTAL STUDIES.
Some Environmental and Social Impacts of the James Bay Hydroelectric Project, Canada,
W82-01908 6G

BROOKHAVEN NATIONAL LAB., UPTON, NY. DEPT. OF ENERGY AND ENVIRONMENT.
Rapid, Quantitative Separation of Chlorophylls and Their Degradation Products by High-Performance Liquid Chromatography,
W82-01619 5A

BUREAU OF RECLAMATION, DENVER, CO. ENGINEERING AND RESEARCH CENTER.
Hydraulic Geometry and Minimum Rate of Energy Dissipation,
W82-01918 2J

Intakes and Outlets for Low-Head Hydropower,
W82-01979 8C

BYELORUSSIA UNIV., MINSK (USSR). EXPERIMENTAL BIOLOGICAL SPECIAL TOPICS RESEARCH LAB.
Use of Knopp's Method to Assess Self-Purification Processes in Water Bodies and Water Courses,
W82-02073 5B

CALIFORNIA STATE DEPT. OF FISH AND GAME, SACRAMENTO. WATER POLLUTION CONTROL LAB.
Acute Toxicities of the Herbicides Komeen and Hydrothol-191 to Golden Shiner (Notemigonus Crysoleucas),
W82-01882 5C

CALIFORNIA STATE DEPT. OF WATER RESOURCES, SACRAMENTO.
The California State Water Project--Current Activities and Future Management Plans.
W82-01851 6E

CALIFORNIA UNIV., BERKELEY.
A Structural Systems Analysis Approach to Determine Optimum Operating Policies for Irrigation and Hydropower Generation for Water Resources, Systems,
W82-01680 6A

CALIFORNIA UNIV., BERKELEY. DEPT. OF CIVIL ENGINEERING.
The Accuracy of Equilibrium Methods of Slope Stability Analysis,
W82-01954 8D

CALIFORNIA UNIV. DAVIS.
Land-Use Conflict in Wildland Watershed Management: A Multiple Objective Economic Analysis,
W82-01675 6A

CALIFORNIA UNIV., DAVIS. DEPT. OF LAND, AIR, AND WATER RESOURCES.
Responses of Grain Sorghum to Variable Water Supply Under Two Irrigation Frequencies,
W82-01944 3F

CALIFORNIA UNIV., DAVIS. DIV. OF ENVIRONMENTAL STUDIES.
Abundance, Life History, and Growth of Introduced Populations of the Opossum Shrimp (Mysis Relicta) in Subalpine California Lakes,
W82-01638 2H

CALIFORNIA UNIV., RIVERSIDE. DEPT. OF SOIL AND ENVIRONMENTAL SCIENCES.
A Proposal for Reclamation by Dilution of Irrigation Water,
W82-01943 3C

The Statistical Mechanical Theory of Groundwater Flow,
W82-01982 2F

CANADA CENTRE FOR INLAND WATERS, BURLINGTON (ONTARIO); AND NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR. GREAT LAKES ENVIRONMENTAL LAB.
Determination of Free Metal Ion Concentrations Using Bioassays,
W82-01821 5A

CARNEGIE INSTITUTION OF WASHINGTON, DC. GEOPHYSICAL LAB.
Tracing Food Webs with Stable Hydrogen Isotopes,
W82-02021 6G

CASE WESTERN RESERVE UNIV., CLEVELAND, OH. DEPT. OF SYSTEMS ENGINEERING.
Parameter Estimation of Rainfall-Runoff Models with Heteroscedastic Streamflow Errors--The Noninformative Data Case,
W82-01657 2A

CENTER OF ADVANCED STUDY IN MARINE BIOLOGY, PORTO NOVO (INDIA).
Distribution of Vibrio Parahaemolyticus in Finfish Harvested from Porto Novo (S. India) Environs: A Seasonal Study,
W82-01737 5A

CENTRAL INLAND FISHERIES RESEARCH INST., BARRACKPORE (INDIA).
Effect of Different Water Salinity Levels and Organic Matter Application on the Composition of Water Soluble and Exchangeable Bases in a Brackishwater Fish Pond Soil,
W82-02027 2H

CENTRAL SOIL SALINITY RESEARCH INST., KARNAL (INDIA).
Effect of Irrigation Practices and Methods of Sowing-Cum-Irrigation on the Performance of Safflower,
W82-01878 3F

CHANDRA SHEKHAR AZAD UNIV. OF AGRICULTURE AND TECHNOLOGY, KANPUR (INDIA).
Water Use, Yield and Quality of Rapeseed as Influenced by Spacing, Irrigation and Time of Harvest When Raised in a Multiple-Cropping System,
W82-02031 3F

CHEST CLINIC, BRISBANE (AUSTRALIA).
Isolation of the Mycobacterium Avium-M. Intracellulare-M. Scrofulaceum Complex from Tank Water in Queensland, Australia,
W82-02069 5A

CHICAGO UNIV., IL. DEPT. OF MEDICINE.
Thermophillic and Thermotolerant Fungi Isolated from the Thermal Effluent of Nuclear Power Generating Reactors: Disposal of Human Opportunistic and Veterinary Pathogenic Fungi,
W82-01928 5B

CHINESE UNIV. OF HONG KONG, SHATIN. DEPT. OF BIOLOGY.
Degree of Pollution of Several Major Streams Entering Tolo Harbour, Hong Kong,
W82-02058 5B

CHIYODA CHEMICAL ENGINEERING AND CONSTRUCTION CO. LTD., YOKOHAMA (JAPAN).
A Multilevel Model and Algorithm for Some Multiobjective Problems,
W82-01884 6A

CHULALONGKORN UNIV., BANGKOK (THAILAND). INST. OF ENVIRONMENTAL RESEARCH.
Activated Sludge Nickel Toxicity Studies,
W82-01895 5D

COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, NH.
An Integral Transform Method for the Linearized Boussinesq Groundwater Flow Equation,
W82-01984 2F

COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA. DEPT. OF MARINE SCIENCE.
The Effects of Chlorinated Sea Water on the Blue Crab, Callinectes Sapidus,
W82-01679 5C

Petroleum Degradation by Naturally Occurring Populations of Marine Bacteria from Middle Atlantic Outer Continental Shelf Waters,
W82-01683 5G

COLORADO STATE UNIV., FORT COLLINS.
Acute Toxicity of an In Situ Shale Oil Process Wastewater and It's Major Components to Daphnia Magna,
W82-01811 5C

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CHEMISTRY.
Applications of Stripping Analysis to Metal Determinations in Natural Waters,
W82-01670 1A

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF CIVIL ENGINEERING.
Hydraulic Testing of Plastic Filter Fabrics,
W82-01613 8G

Numerical Analysis of Transient Salt/Fresh-Water Interface in Coastal Aquifers,
W82-01693 2F

Persistence of 3-(Trifluoromethyl)-4-Nitrophenol in Aquatic Environments,
W82-01798 5B

Optimal Design of Border Irrigation Systems,
W82-01977 3F

COLORADO STATE UNIV., FORT COLLINS. DEPT. OF FOREST AND WOOD SCIENCES.
Environmental and Physiological Control of Water Flux Through Pinus Contorta,
W82-01827 2D

COLORADO STATE UNIV., FORT COLLINS. ENGINEERING RESEARCH CENTER.
Evaluating Scour at Culvert Outlets,
W82-01934 4D

COLORADO UNIV AT BOULDER. DEPT. OF GEOLOGICAL SCIENCES.
Composition of Leachage from Surface-Retorted and Unretorted Colorado Oil Shale,
W82-01810 5B

COLUMBIA NATIONAL FISHERY RESEARCH LAB., MO.
Effects of the Aquatic Herbicide 2,4-D DMA on the Ecology of Experimental Ponds,
W82-01949 5C

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF FOREST RESEARCH.
Transport of Salts in Catchments and Soils,
W82-01880 2G

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF MATHEMATICS AND STATISTICS.
Steady Periodic Flow Through a Rectangular Dam,
W82-01983 2F

COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, NORTH RYDE (AUSTRALIA). DIV. OF FOOD RESEARCH.
Production of Aromatic Acids During Anaerobic Digestion of Citrus Peel,
W82-02049 5D

CONSTRUCTION ENGINEERING RESEARCH LAB., CHAMPAIGN, IL.
R-Factors for Soil Loss Impact Prediction,
W82-01963 2J

COPENHAGEN UNIV. (DENMARK). DEPT. OF GEOGRAPHY.
The Application of Radioactive Tracers for Determination of Bed-Load Transport in Alluvial Rivers,
W82-01893 2J

CORNELL UNIV., ITHACA, NY.
Nitrous Oxide in Freshwaters of the Great Lakes Basin,
W82-01841 2H

CORNELL UNIV., ITHACA, NY. DEPT. OF FOOD SCIENCE.
Using Zeta Potential to Optimize Coagulating Aid Doses Used to Treat Food Processing Wastes,
W82-01627 5D

COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, PRETORIA (SOUTH AFRICA). NATURAL ISOTOPES DIV.
Excess Air in Groundwater,
W82-02099 2F

CUTTER LAB., SHAWNEE, KS. BAYVET DIV.
Parasite Ova in Anaerobically Digested Sludge,
W82-02018 5B

DANISH INST. OF APPLIED HYDRAULICS, HOERSHOLM.
Spatial Simulation of Snow Processes,
W82-01887 2C

DARTMOUTH COLL., HANOVER, NH.
A Perspective on Estuarine and Coastal Research Funding,
W82-01803 9A

DELAWARE UNIV., NEWARK. DEPT. OF CHEMICAL ENGINEERING.
Cycling Zone Adsorption Applied to Purification of Brackish Water with Thermally Regenerable Ion-Exchange Resins,
W82-01696 3A

DEPARTMENT OF AGRICULTURE AND FISHERIES, STELLENBOSCH (SOUTH AFRICA).
Soil Water Studies on Small Lucerne Plots,
W82-01713 2I

DEPARTMENT OF AGRICULTURE, LACOMBE (ALBERTA). RESEARCH STATION.
Deposition of Sulphur Gases from Multiple Scattered Sources in Alberta,
W82-01868 5B

DEPARTMENT OF FISHERIES AND OCEANS, WINNEPEG (MANITOBA). FRESHWATER INST.
An Analysis of the Aquatic Macrophyte, Myriophyllum Exalbescens, as an Indicator of Metal Contamination of Aquatic Ecosystems near a Base Metal Smelter,
W82-02016 5A

DEPARTMENT OF FISHERIES AND OCEANS, WINNIPEG (MANITOBA). FRESHWATER INST.
Mercury Methylation by Fish Intestinal Contents,
W82-01830 5C

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, CHRISTCHURCH (NEW ZEALAND). CHEMISTRY DIV.
Bromide in Canterbury Ground Water,
W82-02056 5B

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH, TAUPO (NEW ZEALAND). ECOLOGY DIV.
Benthic Macroinvertebrates of Lake Taupo,
W82-01702 2H

DETROIT DEPT. OF WATER SUPPLY, MI. WATER AND SEWER TREATMENT.
Detroit's WWTP: One of the World's Biggest,
W82-01865 5D

DOMTAR LTD. RESEARCH CENTER, SENNEVILLE (ONTARIO).
Removal of Elemental Mercury from Wastewaters Using Polysulfides,
W82-01800 5D

DORCHESTER COUNTY HEALTH DEPARTMENT, CAMBRIDGE, MD.
Influence on Groundwater from the Bermed Infiltration Pond,
W82-01622 5D

DUKE UNIV., DURHAM, NC. DEPT. OF CIVIL ENGINEERING.
Modeling Stormwater Storage/Treatment Transients: Theory,
W82-01980 2A

Modeling Stormwater Storage/Treatment Transients: Applications,
W82-01981 2E

DURHAM UNIV. (ENGLAND). DEPT. OF BOTANY.
Phytobenthos of the River Tees and Its Tributaries,
W82-02065 2K

EAST CAROLINA UNIV., GREENVILLE, NC. DEPT. OF SOCIOLOGY AND ANTHROPOLOGY.
Relating Population Growth to Shellfish Bed Closures: A Case Study from North Carolina,
W82-01641 5C

EBASCO SERVICES, INC., GREENSBORO, NC.
Geologic and Hydrologic Implications of Hazardous Wastes Management Rules on Siting in North Carolina,
W82-01630 5E

EIDGENOESSISCHE ANSTALT FUER WASSERVERSORGUNG, ABWASSERREINIGUNG UND GEWAESSERSCHUTZ, ZURICH (SWITZERLAND).
Transport of Nonpolar Organic Compounds from Surface Water to Groundwater. Laboratory Sorption Studies,
W82-01873 5B

EIDGENOESSISCHE TECHNISCHE HOCHSCHULE, ZURICH (SWITZERLAND). VERSUCHSANSTALT FUER WASSERBAU, HYDROLOGIE UND GLAZIOLOGIE.
Simulation of the Topographic Influence on SLAR Data for Soil Moisture Detection in a Hilly Area,
W82-01605 2G

Can We Model the Rainfall-Runoff Process Today,
W82-01609 2A

ENERGY POLICY STUDIES, INC., OMAHA.
The Lake Tahoe Basin: A Systems Analysiw of Its Characteristics and Human Carrying Capacity,
W82-01807 6A

ENVIRONMENTAL CONTROL CONSULTANCY SERVICES LTD., LONDON (ENGLAND).
Technical and Economic Implications of Installing an Industrial Waste-Water Pretreatment Plant,
W82-02044 5D

ENVIRONMENTAL HEALTH DIRECTORATE, OTTAWA (ONTARIO).
A National Survey of Tri(Haloalkyl)-, Trialkyl-, and Triarylphosphates in Canadian Drinking Water,
W82-01989 5B

ENVIRONMENTAL PROTECTION AGENCY, ANN ARBOR, MI.
Flow Calculations for Household Effluent Disposal in Elevated Sand Mounds,
W82-01660 5E

ENVIRONMENTAL PROTECTION AGENCY, RESEARCH TRIANGLE PARK, NC.
Environmental Assessment of Industrial Discharges Based on Multiplicative Models,
W82-01808 5B

ENVIRONMENTAL PROTECTION AGENCY, WASHINGTON, DC.
Predicting Priority Pollutants from Petrochemical Processes,
W82-01809 5B

ENVIRONMENTAL PROTECTION SERVICE, OTTAWA (ONTARIO). WATER POLLUTION CONTROL DIRECTORATE.
Standard Procedure for Testing the Acute Lethality of Liquid Effluents.
W82-01905 5A

ENVIRONMENTAL RESEARCH LAB.-DULUTH, MN.
Determination of Mineral Fiber Concentrations in Fish Tissues,
W82-01822 5C

ENVIROTECH CORP., SALT LAKE CITY, UT.
Technology and Performance of the Hi-Capacity Thickener,
W82-01929 5D

EOTOVS LORAND UNIV., BUDAPEST (HUNGARY). DEPT. OF PHYSICAL CHEMISTRY AND RADIOLOGY.
Penetration and Distribution of Tritiated Water in Soils of a Lysimeter,
W82-01886 2G

ESSO PETROLEUM CO. LTD., LONDON (ENGLAND).
The Value of Ecological Monitoring in the Management of Petroleum Industry Effluent Discharges: Experience in Esso Petroleum Company U.K. Refineries,
W82-01913 5G

EXPERIMENTAL RESEARCH AND TECHNOLOGY, INC., CONCORD, MA.
Pollution Control: Changing Approaches,
W82-01870 6E

FEDERAL ENERGY REGULATORY COMMISSION, ATLANTA, GA. ATLANTA REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing: Altamaha River Basin, Georgia,
W82-01764 6D

FEDERAL ENERGY REGULATORY COMMISSION, CHICAGO, IL. CHICAGO REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing; Menominee River Basin; Michigan, Wisconsin,
W82-01753 6D

Water Resources Appraisals for Hydroelectric Licensing; Grand River Basin, Michigan,
W82-01759 6D

FEDERAL ENERGY REGULATORY COMMISSION, FORT WORTH, TX. FORT WORTH REGIONAL OFFICE.
Water Resources Appraisals for Hydroelectric Licensing; Lower Red River Basin; Arkansas, Louisiana, Oklahoma and Texas,
W82-01754 6D

FEDERAL ENERGY REGULATORY COMMISSION, NEW YORK. NEW YORK REGIONAL OFFICE.
Water Resources Appraisal for Hydroelectric Licensing; Kennebec River Basin, Maine.
W82-01755 6D

Water Resources Appraisal for Hydroelectric Licensing; Potomac River Basin; Pennsylvania, Maryland, West Virginia, Virginia, and District of Columbia,
W82-01760 6D

Water Resources Appraisal for Hydroelectric Licensing: Penobscot River Basin, Maine,
W82-01763 6D

FEDERAL ENERGY REGULATORY COMMISSION, WASHINGTON, DC. OFFICE OF ELECTRIC POWER REGULATION.
Water Resources Appraisals for Hydroelectric Licensing: Allegheny River Basin; Pennsylvania-New York.
W82-01751 6D

Water Resources Appraisals for Hydroelectric Licensing; Colorado River Basin, Texas.
W82-01752 6D

Water Resources Appraisals for Hydroelectric Licensing; Cumberland River Basin; Kentucky-Tennessee.
W82-01756 6D

Water Resources Appraisals for Hydroelectric Licensing; Tombigbee-Warrior River Basin; Alabama-Mississippi.
W82-01757 6D

Water Resources Appraisals for Hydroelectric Licensing; Black River Basin, New York.
W82-01758 6D

Water Resources Appraisals for Hydroelectric Licensing: Upper Arkansas River Basin; Colorado, Kansas, and New Mexico.
W82-01761 6D

Water Resources Appraisals for Hydroelectric Licensing; Western Great Lakes Tributaries; Michigan, Wisconsin, Indiana and Illinois.
W82-01762 6D

Water Resources Appraisals for Hydroelectric Licensing; Santee River Basin; South Carolina-North Carolina.
W82-01765 6D

Water Resources Appraisals for Hydroelectric Licensing: Tennessee River Basin; Virginia-Tennessee-North Carolina-Mississippi, Georgia-Kentucky-Alabama.
W82-01766 6D

Water Resources Appraisals for Hydroelectric Licensing, Saginaw and Au Sable River Basins Area, Michigan.
W82-01767 6D

FEDERAL INST. FOR SNOW AND AVALANCHE RESEARCH, DAVOS/WEISSFLUHJOCH (SWITZERLAND).
Limitations in Hydrological Interpretations of the Snow Coverage,
W82-01889 2C

FEDERAL INST. ON WATER RESOURCES RESEARCH (SWITZERLAND).
Water Quality Management of Lake Neusiedler, Austria,
W82-02090 5C

FINNISH HYDROLOGICAL OFFICE, HELSINKI.
On the Values and Variability of Degree-Day Melting Factor in Finland,
W82-01735 2C

FISH AND WILDLIFE SERVICE, WASHINGTON, DC. OFFICE OF FISHERY ASSISTANCE.
Impacts of Navigational Dredging on Fish and Wildlife: A Literature Review,
W82-01768 6G

FISHERIES RESEARCH STATION, ABERDEEN (HONG KONG).
Some Effects of Sewage Discharge Upon Phytoplankton in Hong Kong,
W82-02095 5C

FLORIDA INTERNATIONAL UNIVERSITY, MIAMI. DRINKING WATER QUALITY RESEARCH CENTER.
Nitrates, Chlorates and Trihalomethanes in Swimming Pool Water,
W82-01835 5A

FLORIDA STATE DEPT. OF ENVIRONMENTAL REGULATION, TALLAHASSEE,
Estuarine Dredge and Fill Activities: A Review of Impacts,
W82-01805 2L

FLORIDA UNIV., BELLE GLADE. DEPT. OF AGRICULTURAL ENGINEERING.
Effect of Bulk Density on Calibration of Neutron Moisture Probe for Organic Soils,
W82-01861 2G

FLORIDA UNIV., GAINESVILLE.
The Effects of Secondary Sewage Effluent on the Water Quality, Nutrient Cycles and Mass Balances, and Accumulation of Soil Organic Matter in Cypress Domes,
W82-01687 5G

FLORIDA UNIV., GAINESVILLE. DEPT. OF BOTANY.
Biological and Physical Investigations of Bodies of Water Beneath Dense Water Hyacinth Populations Before and After Chemical Treatment,
W82-01678 5B

FOREST RESEARCH INST., CHRISTCHURCH (NEW ZEALAND).
Hydrology of Okarito Lagoon and the Inferred Effects of Selective Logging in Okarito Forest,
W82-01703 4C

FORSCHUNGSINST. BERGHOF G.M.B.H., TUEBINGEN (GERMANY, F.R.).
Selective Removal of Heavy Metal Ions from Aqueous Solutions by Diafiltration of Macromolecular Complexes,
W82-01900 5D

FRESHWATER BIOLOGICAL ASSOCIATION, CUMBRIA (ENGLAND). WINDERMERE LAB.
The Population Ecology of Iron Bacteria (Genus Ochrobium) in a Stratified Eutrophic Lake,
W82-01997 2H

FRESHWATER BIOLOGICAL ASSOCIATION, WAREHAM (ENGLAND). RIVER LAB.
The Effects of Mine Drainage and Organic Enrichment on Benthos in the River Nent System, Northern Pennines,
W82-02053 5C

GEOLOGICAL SURVEY, ALBANY, NY. WATER RESOURCES DIV.
Surficial Geology of Dugway Quadrangle, Oswego County, New York,
W82-01775 7C

GEOLOGICAL SURVEY, DENVER, CO. WATER RESOURCES DIV.
Sediment Analyses for Selected Sites in the South Platte River in Colorado and Nebraska, and the North Platte and Platte Rivers in Nebraska--Suspended Sediment, Bedload, and Bed Material,
W82-01776 2J

GEOLOGICAL SURVEY, HELENA, MT. WATER RESOURCES DIV.
Selected Drill-Stem-Test Data from the Northern Great Plains Area of Montana,
W82-01774 7C

Selected Hydrogeologic Data from the Northern Great Plains Area of Montana,
W82-01777 7C

Water-Resources Investigations of the U.S. Geological Survey in Montana, October 1980 through September 1981,
W82-01787 7C

GEOLOGICAL SURVEY, HURON, SD. WATER RESOURCES DIV.
Records of Water Levels in Unconsolidated Deposits in Eastern South Dakota,
W82-01788 7C

GEOLOGICAL SURVEY, JACKSON, MS. WATER RESOURCES DIV.
Quality of Water and Time of Travel in Part of Tillatoba Creek Basin, Mississippi, October 1974 to September 1980,
W82-01791 7C

GEOLOGICAL SURVEY, LAKEWOOD, CO. WATER RESOURCES DIV.
Effects of a Cattle Feedlot on Ground-Water Quality in the South Platte River Valley Near Greeley, Colorado,
W82-01790 5B

GEOLOGICAL SURVEY, LINCOLN, NE. WATER RESOURCES DIV.
Groundwater Levels in Nebraska 1980,
W82-01785 2F

GEOLOGICAL SURVEY, MENLO PARK, CA.
Tectonic State: Its Significance and Characterization in the Assessment of Seismic Effects Associated with Reservoir Impounding,
W82-01951 8E

GEOLOGICAL SURVEY, MENLO PARK, CA. WATER RESOURCES DIV.
Addendum to: Sources of Powerplant Cooling Water in the Desert Area of Southern California--Reconnaissance Study,
W82-01773 6B

Denitrification Associated With Periphyton Communities,
W82-01814 5B

GEOLOGICAL SURVEY, NASHVILLE, TN. WATER RESOURCES DIV.
Low-Flow Frequency and Flow Duration of Tennessee Streams,
W82-01779 2E

Hydrogeology of the Gatlinburg Area, Tennessee,
W82-01782 2F

GEOLOGICAL SURVEY, RESTON, VA. WATER RESOURCES DIV.
Organic Substances in Water,
W82-01783 5A

Infectious Waterborne Diseases,
W82-01784 5A

Microbiology of the Aquatic Environment,
W82-01786 5C

Multi-Saline Sample Distillation Apparatus for Hydrogen Isotope Analyses: Design and Accuracy,
W82-01789 3A

Biota and Biological Parameters as Environmental Indicators,
W82-01794 5C

GEOLOGICAL SURVEY, TACOMA, WA. WATER RESOURCES DIV.
Low-Flow Characteristics of Streams in the Deschutes River Basin, Washington,
W82-01781 2E

Sediment Data for Streams Near Mount St. Helens, Washington--Volume 1, 1980 Water-Year Data,
W82-01792 7C

GEOLOGICAL SURVEY, TALLAHASSEE, FL. WATER RESOURCES DIV.
U.S. Geological Survey Reports on the Water Resources of Florida, 1886-1980, Second Edition,
W82-01778 10C

Hydrogeology of Well-Field Areas Near Tampa, Florida, Phase 1--Development and Documentation of a Two-Dimensional Finite-Difference Model for Simulation of Steady-State Ground-Water Flow,
W82-01780 6A

GEOLOGICAL SURVEY, URBANA, IL. WATER RESOURCES DIV.
Stage-Discharge Relations at Dams on the Illinois and Des Plaines Rivers in Illinois,
W82-01793 4A

GEORGIA INST. OF TECH., ATLANTA. SCHOOL OF CIVIL ENGINEERING.
Mixing Zone Analysis for River Plumes,
W82-01961 5B

GEORGIA UNIV., ATHENS. DEPT. OF ZOOLOGY.
The Relative Importance of Protozoans, Rotifers, and Crustaceans in a Freshwater Zooplankton Community,
W82-01840 2H

GORKII STATE UNIV. (USSR).
Estimation of the Production of Planktonic Infusorians in Connection with Fluctuations in Their Abundance,
W82-02072 2H

GOSUDARSTVENNYI GIDROLOGICHESKII INST., LENINGRAD (USSR).
The Effects of Man on Basin Runoff, and on the Water Balance and Water Stage of the Caspian Sea,
W82-01709 4C

GOVIND BALLABH PANT UNIV. OF AGRICULTURE AND TECHNOLOGY, PANTNAGAR (INDIA).
Note on the Role of Irrigation Frequencies on the Regrowth of Berseem,
W82-01745 2I

GOVIND BALLABH PANT UNIV. OF AGRICULTURE AND TECHNOLOGY, PANTNAGAR (INDIA). DEPT. OF SOIL SCIENCE.
Effect of Soil Moisture Stress on Legume-Rhizobium Symbiosis in Soybeans,
W82-01846 2I

GRIFFITH UNIV., BRISBANE, QUEENSLAND (AUSTRALIA). SCHOOL OF AUSTRALIAN ENVIRONMENTAL STUDIES.
Kinematic Flow Approximation of Runoff on a Plane: An Exact Analytical Solution,
W82-01617 2A

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Properties of the Sorptivity for Exponential Diffusivity and Application to the Measurement of the Soil Water Diffusivity,
W82-01897 2G

GROUPEMENT NATIONAL D'ETUDES DES FLEAUX ATMOSPHERIQUES, GRENOBLE (FRANCE).
Various Kinetic Energy Characteristics of Hail-patterns in the Grossversuch IV Experiment,
W82-01732 2B

HARVARD SCHOOL OF PUBLIC HEALTH, BOSTON, MA. DEPT. OF EPIDEMIOLOGY.
An Alternative for Meeting the Nitrate Standard for Public Water Supplies,
W82-01623 5C

HARWELL LAB., OXON (ENGLAND). ENVIRONMENTAL AND MEDICAL SCIENCES DIV.
The Dynamics of Anaerobic Phenol Biodegradation in Lower Greenland,
W82-02071 5B

HARYANA AGRICULTURAL UNIV., HISSAR (INDIA).
Effect of Profile Soil Moisture and Phosphorus Levels on the Growth and Yield of Anonutrient Uptake by Chickpea,
W82-02042 2I

HAWAII UNIV., AT MANOA, HONOLULU. WATER RESOURCES RESEARCH CENTER.
Simple In Situ Determination of Hydraulic Conductivity by Power Function Descriptions of Drainage,
W82-01666 2G

HEALTH AND WELFARE CANADA, OTTAWA (ONTARIO).
Determination of Hexachlorocyclopentadiene at the Nanogram Per Liter Level in Drinking Water,
W82-01819 5A

HILL (G.H.), MANCHESTER (ENGLAND).
Sulby Reservoir - Providing Water for the Isle of Man,
W82-02068 8A

HONG KONG UNIV. DEPT. OF BOTANY.
Stream Pollution in Hong Kong - An Appraisal,
W82-02084 5B

HUMBOLDT STATE UNIV., ARCATA, CA. DEPT. OF FISHERIES.
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W82-01906 3C

HYDROMETEOROLOGICAL SURVEY OF THE CATCHMENTS OF LAKES VICTORIA, KYOGA AND MOBUTU SESE SEKO, ENTEBBE (UGANDA).
Recent Changes in Level of Lake Victoria,
W82-01711 4A

IFE UNIV. (NIGERIA). DEPT. OF GEOGRAPHY.
Components of Saturated Zone Thickness in a Nigerian Basement Complex Regolith,
W82-01710 2F

ILLINOIS STATE UNIV., NORMAL. DEPT. OF ECONOMICS.
Water Quality and the Demand for Recreation,
W82-01942 6D

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF AGRICULTURAL ECONOMICS.
The Economics of Cooperation Over Collective Bads,
W82-01909 6A

ILLINOIS UNIV. AT URBANA-CHAMPAIGN. DEPT. OF CIVIL ENGINEERING.
Substrate Flux into Biofilms of Any Thickness,
W82-01964 5D

INDIANA UNIV. AT BLOOMINGTON. DEPT. OF CHEMISTRY.
Organic Compounds Found Near Dump Sites in Niagara Falls, New York,
W82-01802 5B

INSTITUT FUER MEERESFORSCHUNG, BREMERHAVEN (GERMANY, F.R.). DEPT. OF BOTANY.
On Some Chytrids Found in Estuarine Habitats,
W82-02038 2L

INSTITUT FUER WASSERWIRTSCHAFT, BERLIN (GERMAN D.R.).
Experience with Lake and Reservoir Restoration Techniques in the German Democratic Republic,
W82-02054 2H

INSTITUTE FOR MARINE ENVIRONMENTAL RESEARCH, PLYMOUTH (ENGLAND).
Seasonal and Spring-Neap Tidal Dependence of Axial Dispersion Coefficients in the Severn - A Wide, Vertically Mixed Estuary,
W82-01749 2L

INSTITUTE FOR SOIL FERTILITY, GRONINGEN (NETHERLANDS). DELFT HYDRAULIC LAB.
Field Observations of the Isotopic Composition of Particulate Organic Carbon in the Southern North Sea and Adjacent Estuaries,
W82-01714 2J

INSTITUTE OF CIVIL AND CONSTRUCTION ENGINEERING, SPLIT (YUGOSLAVIA). FACULTY OF CIVIL ENGINEERING.
Accuracy of Suspended Sediment Measurements in Natural Streamflows,
W82-02002 2J

INSTITUTE OF GENERAL AND MUNICIPAL HYGIENE, MOSCOW (USSR).
Water Sanitation Legislation Regarded as the Basis of Water Quality Monitoring,
W82-01990 6E

INSTITUTE OF OCEANOGRAPHIC SCIENCES, TAUNTON (UNITED KINGDOM).
Distribution, Morphology, and Origin of Sedimentary Furrows in Cohesive Sediments, Southampton Water,
W82-01720 2L

INSTITUTE OF PAPER CHEMISTRY, APPLETON, WI.
Device for Collecting Replicate Artificial Substrate Samples of Benthic Invertebrates in Large Rivers,
W82-01947 7B

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT, WASHINGTON, DC. POLICY PLANNING DIV.
Long-Run Effects of Environmental Regulation,
W82-01848 6A

INTERNATIONAL INST. OF TROPICAL AGRICULTURE, IBADAN (NIGERIA).
Leaching of Fertilizer Ions in a Ultisol from the High Rainfall Tropics: Leaching Through Undisturbed Soil Columns,
W82-01721 2G

IOWA STATE UNIV., AMES.
The Management of Water Resources: A Synthesis of Goal Programming and Input-Output Analysis with Application to the Iowa Economy,
W82-01685 6A

A Model of the Antarctic Sink for Stratospheric Water Vapor,
W82-01686 2A

IOWA UNIV., IOWA CITY. DEPT. OF CIVIL ENGINEERING.
River Thermal Standards Costs in the Upper Midwest,
W82-01655 6B

IOWA UNIV., IOWA CITY. INST. OF HYDRAULIC RESEARCH.
Cooling Potential of Missouri River in Missouri,
W82-01654 5B

IRKUTSKII GOSUDARSTVENNYI UNIV. (USSR). BIOLOGICAL AND GEOGRAPHICAL RESEARCH INST.
Toxicant Accumulation in Hydrobiont Tissues Following Effluent Discharge,
W82-01919 5C

Calculation of Brachionus Rubens Production by the Direct Method and by Edmondson's Method,
W82-01921 2H

IRRIGATED AGRICULTURE RESEARCH AND EXTENSION CENTER, PROSSER, WA.
Influence of Trickle and Sprinkle Irrigation on Golden Delicious Apple Quality,
W82-02001 3F

JOHN HOPKINS UNIV., BALTIMORE, MD. DIV. OF GEOGRAPHIC MEDICINE.
Gauze Filtration and Enrichment Procedures for Recovery of Vibrio Cholerae From Contaminated Waters,
W82-01815 5A

JOHNSON CO., HASLETT, MI.
Screened Auger Aids Investigation,
W82-02096 7B

KAMARAJ UNIV., MADURAI (INDIA). SCHOOL OF BIOLOGICAL SCIENCES.
Seasonal and Diurnal Changes of Chlorophyll in a Tropical Fresh Water Impoundment,
W82-02052 2H

KANSAS STATE GEOLOGICAL SURVEY, LAWRENCE.
Measurement of Irrigated Acreage in Western Kansas from Landsat Images,
W82-01939 7B

KASPIISKII NAUCHNO-ISSLEDOVATELSKII INST. RYBNOGO KHOZYAISTVA, ASTRAKHAN (USSR).
Effect of Fertilizers on the Primary and Bacterial Production of Rearing Ponds in the Volga Delta,
W82-02077 2H

KENTUCKY UNIV., LEXINGTON. DEPT. OF AGRONOMY.
Simulation of Soil Water Within the Root Zone of a Corn Crop,
W82-01834 2G

KERNFORSCHUNGSANLAGE JUELICH, G.M.B.H. (GERMANY, F.R.). INST. FUER CHEMIE.
Voltammetric Studies on the Stability of the ZN(II) Chelates with NTA and EDTA and the Kinetics of their Formation in Lake Ontario Water,
W82-01839 2H

KHARKOV UNIV. (USSR).
The Hydroflora of Urban Ponds as an Index of Their Sanitary and Biological State,
W82-01924 2H

KYUSHU UNIV., FUKUOKA (JAPAN). DEPT. OF ORGANIC SYNTHESIS.
Extraction of Copper with Liquid Surfactant Membranes,
W82-01896 5D

LAMONT-DOHERTY GEOLOGICAL OBSERVATORY, PALISADES, NY.
Salt Dispersion in the Hudson Estuary,
W82-01615 2L

Summer Ice and Carbon Dioxide,
W82-01843 2C

LANCASTER UNIV., BAILRIGG (ENGLAND). DEPT. OF ENVIRONMENTAL SCIENCES.
Americium in Intertidal Sediments from the Coastal Environs of Windscale,
W82-02098 5B

LANCHESTER POLYTECHNIC, CONVENTRY (ENGLAND). DEPT. OF GEOGRAPHY.
The Use of Specific Conductance in Studies of Natural Waters and Soil Solutions,
W82-01646 7A

LAVAL UNIV. (QUEBEC). DEPT. OF CHEMISTRY.
Temporal and Spatial Variations of Mercury, Lead, Zinc, and Copper in Sediments of the Saguenay Fjord,
W82-01639 5B

Spatial and Temporal Variations in Cesium-137 and Carbon in Sediments of Saguenay Fjord (Variations Spatiales et Temporelles du Cesium-137 et du Carbone dans des Sediments du Fjord du Saguenay),
W82-01644 2J

LAW ENGINEERING TESTING CO., MARIETTA, GA.
Geologic Aspects of Waste Disposal Site Evaluations,
W82-02011 5E

LEEDS UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING.
A Selective Medium for the Enumeration of Streptococcus Bovis by Membrane Filtration,
W82-01620 5A

LEICESTER UNIV. (ENGLAND). DEPT. OF ECONOMICS.
Charging Policies for Water Services,
W82-01734 6C

LEWIS AND CLARK COLL. PORTLAND, OR. NORTHWESTERN SCHOOL OF LAW.
Hydropower vs. Salmon: The Struggle of the Pacific Northwest's Anadromous Fish Resources for a Peaceful Coexistence with the Federal Columbia River Power System,
W82-01804 6E

LIMOGES UNIV. (FRANCE). FONDATION DE L'EAU LIMOGES.
Combining Sewer Water Purification Processes to Treat Effluents Produced by Transient Populations,
W82-01992 5D

LIVINGSTON COLL., NEW BRUNSWICK, NJ. DEPT. OF URBAN STUDIES.
Planning with Great Uncertainty: A Review and Case Study of the Safe Drinking Water Controversy,
W82-01606 5A

LOUISIANA STATE UNIV., BATON ROUGE. DEPT. OF GEOLOGY.
Diffusion of Sediment on the Lee of Dune-Like Bedforms: Theoretical and Numerical Analysis,
W82-01842 2J

LOUISIANA STATE UNIV., BATON ROUGE. LAB. FOR WETLAND SOILS AND SEDIMENTS.
Nitrous Oxide Emission from Simulated Overland Flow Wastewater Treatment Systems,
W82-01624 5D

Nitrate Reduction to Ammonium and Organic Nitrogen in an Estuarine Sediment,
W82-01625 5B

LOZIER ENGINEERS, INC., ROCHESTER, NY.
Simulating Effects of Combined Sewer Overflows,
W82-01864 6A

LULEA UNIV. (SWEDEN). DIV. OF WATER RESOURCES ENGINEERING.
Evaporation from a Snow Cover--Review and Discussion of Measurements,
W82-01888 2D

LUXEMBOURG FOUNDATION UNIV., ARLON.
Direct Evidence of Water-Soluble Organic Matter Leaching in Brown Earths and Slightly Podzolized Soils,
W82-02034 2G

LYON-1 UNIV., VILLEURBANNE (FRANCE). DEPT. DE BIOLOGIE ANIMAUX ET ZOOLOGIE.
A Simple Device for Quantitative Pseudoperiphyton Sampling,
W82-01894 7B

MADHYA PRADESH IRRIGATION DEPT., BHOPAL (INDIA).
The Chambal Project: Problems and Solutions,
W82-01739 4A

MADRAS UNIV. (INDIA). CENTRE OF ADVANCED STUDY IN BOTANY.
Aquatic Microbiology with Reference to Tannin Degradation,
W82-02028 5B

MAINE UNIV. AT ORONO. DEPT. OF ZOOLOGY AND COLUMBIA NATIONAL FISHERIES RESEARCH LAB., MO.
Effect of an Aerial Application of Carbaryl on Brook Trout (Salvelinus Fontinalis),
W82-01818 5C

MARYLAND DEPT. OF NATURAL RESOURCES, ANNAPOLIS.
The Hazards of Hazardous Waste Management,
W82-01940 6E

MARYLAND TECHNICAL ADVISORY SERVICE, COLLEGE PARK.
Public Opinion and Interest Group Positions on Chesapeake Bay Issues: Implications for Resource Management,
W82-01642 6B

MARYLAND UNIV., COLLEGE PARK.
Investigations into the Dynamics of Water Movement on a Low Relief Landscape on the Eastern Shore of Maryland,
W82-01673 2F

Analysis of the Origin of Water Which Forms Large Aufeis Fields on the Arctic Slope of Alaska Using Ground and Landsat Data,
W82-01690 2C

MARYLAND UNIV., COLLEGE PARK. DEPT. OF CHEMISTRY.
A Gel Partition Model for Organic Desorption from a Pond Sediment,
W82-01844 5A

MARYLAND UNIV., COLLEGE PARK. DEPT. OF MICROBIOLOGY.
Numerical Taxonomy Analysis of Bacteria Isolated from the Completed 'Most Probable Numbers' Test for Coliform Bacilli,
W82-01911 5A

MASSACHUSETTS INST. OF TECH., CAMBRIDGE.
The Geochemical Control of Seawater (Sillen Revisited),
W82-01936 2K

MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF CIVIL ENGINEERING.
Intraseasonal Water Allocation in Deficit Irrigation,
W82-01916 3F

Probabilistic Stability Analysis of Earth Slopes,
W82-01952 8D

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Ecological Characteristics of the Rhizosphere Microflora of Myriophyllum Heterophyllum,
W82-01796 4A

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W82-01640 5C

MCGILL UNIV., MONTREAL (QUEBEC). DEPT. OF CIVIL ENGINEERING AND APPLIED MECHANICS.
The Spreading of Thin Liquid Films on a Water-Air Interface,
W82-01955 1B

The Containment of an Oil Slick by a Boom Placed Across a Uniform Stream,
W82-01956 1B

MCMASTER UNIV., HAMILTON (ONTARIO). DEPT. OF CIVIL ENGINEERING AND ENGINEERING MECHANICS.
Power Spectral Analysis of a Forcemain Failure Caused by Waterhammer,
W82-01826 7B

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF AGRICULTURAL ENGINEERING.
Drip Irrigation Uniformity Considering Emitter Plugging,
W82-01860 3F

MICHIGAN STATE UNIV., EAST LANSING. DEPT. OF CROP AND SOIL SCIENCES.
The Role of Phototrophic Bacteria in the Sulfur Cycle of a Meromictic Lake,
W82-01831 2H

MICHIGAN STATE UNIV., HICKORY CORNERS, KELLOGG BIOLOGICAL STATION.
Aluminum Sulfate Treatment: Short-Term Effect on Complex Phosphorus Compounds in a Eutrophic Lake,
W82-01833 5F

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ATMOSPHERIC AND OCEANIC SCIENCE.
Southern Lake Michigan Sediments: Changes in Accumulation Rate, Mineralogy, and Organic Content,
W82-01958 2J

MICHIGAN UNIV., ANN ARBOR. DEPT. OF CIVIL ENGINEERING.
Mathematical Model for Regional Land Subsidence Due to Pumping 1. Integrated Aquifer Subsidence Equations Based on Vertical Displacement Only,
W82-01926 2F

Mathematical Model for Regional Land Subsidence Due to Pumping 2 Integrated Aquifer Subsidence Equations for Vertical and Horizontal Displacements,
W82-01927 2F

MICHIGAN UNIV., ANN ARBOR. DEPT. OF ENVIRONMENTAL AND INDUSTRIAL HEALTH.
The Contributions of Temperature and the Input of Organic Matter in Controlling Rates of Sediment Methanogenesis,
W82-01832 2H

MICHIGAN UNIV., ANN ARBOR. GREAT LAKES AND MARINE WATERS CENTER.
Inorganic Chemistry of Particulate Matter from the Nearshore Zone of Lake Michigan,
W82-01959 2H

MIDDLE TENNESSEE STATE UNIV., MURFREESBORO.
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W82-01817 5B

MIDDLESEX POLYTECHNIC, LONDON (ENGLAND).
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W82-01994 5G

MIDWEST RESEARCH INST., KANSAS CITY, MO.
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W82-01801 5B

MINISTERE DES TRAVAUX PUBLICS ET DES COMMUNICATIONS, RABAT (MOROCCO). DIRECTION DE L'HYDRAULIQUE.
Morocco's Largest Multipurpose Scheme,
W82-01724 8A

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Hydrocarbon Concentrations in Water and Sediments from UK Marine Waters, Determined by Fluorescence Spectroscopy,
W82-02097 5B

MINISTRY OF AGRICULTURE, STOCKHOLM (SWEDEN). ENVIRONMENTAL DIV.
International Cooperation to Protect the Baltic,
W82-02087 6E

MINISTRY OF TRANSPORT AND PUBLIC WORKS, MIDDELBURG (NETHERLANDS). ENVIRONMENTAL RESEARCH DIV.
Water Quality Impacts Exchanging Water Between Sea and a Closed Estuary,
W82-01991 5G

MINNESOTA UNIV., DULUTH. DEPT. OF PHYSICS.
Resonant Oscillation in Duluth-Superior Harbor,
W82-01837 2H

MINNESOTA UNIV., MINNEAPOLIS. DEPT. OF GEOLOGY AND GEOPHYSICS.
Contourites in Lake Superior,
W82-01935 2H

MINNESOTA UNIV., MINNEAPOLIS. SCHOOL OF PUBLIC HEALTH.
Water Quality Study -- Southwest Minnesota Public Water Supplies,
W82-01795 2K

MISSOURI UNIV.-COLUMBIA. SCHOOL OF FORESTRY, FISHERIES AND WILDLIFE.
Fate of Kepone and Mirex in a Model Aquatic Environment: Sediment, Fish, and Diet,
W82-01820 5B

MOBAY CHEMICAL CORP., KANSAS CITY, MO. DIV. OF AGRICULTURAL CHEMICALS.
Matacil Residue Determination in Foliage, Fish, Soil and Water,
W82-01621 5A

MODO-CHEMETICS, A. B., ORNSKOLDSVIK (SWEDEN).
Oxygen Bleaching Shows Potential for Reducing Costs, Effluent Problems,
W82-01899 5D

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Log Pearson III Distribution - Effect of Dependence, Distribution Parameters and Sample Size on Peak Annual Flood Estimates,
W82-01649 2E

Log Pearson III Distribution - An Empirically-Derived Plotting Position,
W82-01650 2E

Log Pearson III Distribution - Is It Applicable to Flood Frequency Analysis of Australian Streams,
W82-01731 2E

MONTANA STATE UNIV., BOZEMAN. FISHERIES BIOASSAY LAB.
Increased Toxicity of Ammonia to Rainbow Trout (Salmo Gairdneri) Resulting from Reduced Concentrations of Dissolved Oxygen,
W82-01629 5C

MOSCOW STATE UNIV. (USSR).
Seasonal Variations in the Actual Fecundity of Daphnia Magna in a Laboratory Culture,
W82-02083 5C

MOTOR-COLUMBUS CONSULTING ENGINEERS, INC., BADEN (SWITZERLAND).
Flood Control on the Parana and Paraguay Rivers,
W82-01707 2E

MURDOCH UNIV. (WESTERN AUSTRALIA).
Water: A Low-Priced But High-Cost Resource,
W82-02061 6C

NALCO ENVIRONMENTAL SCIENCES, NORTHBROOK, IL.
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W82-01950 7B

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Mathematical Modeling of Stream Water Quality by a New Moment Method: Field Investigation of a Tidal River, W82-01995 7B

NATIONAL COAL BOARD, STOKE ORCHARD (ENGLAND). COAL RESEARCH ESTABLISHMENT.
Removal of Organics from Water by Granular Activated Carbon and Microorganisms, W82-01628 5D

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Parasite Egg and Cyst Reduction in Oxidation Ditches and Aerated Lagoons, W82-01733 5D

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Water-Ice and Water-Updraft Relationships Near -10 Degrees C Within Populations of Florida Cumuli, W82-01968 2B

NATIONAL HYDROLOGY RESEARCH INST., CALGARY (ALBERTA).
Morphology, Hydrology and Hydrochemistry of Karst in Permafrost Terrain Near Great Bear Lake, Northwest Territories, W82-01904 2F

NATIONAL HYDROLOGY RESEARCH INST., OTTAWA (ONTARIO).
Scale-Dependent Dispersion in a Stratified Granular Aquifer, W82-01986 2F

NATIONAL INST. FOR WATER RESEARCH, PRETORIA (SOUTH AFRICA).
Health Aspects of Organic Substances in South African Waters - Opinions and Realities, W82-01712 5A

Comparison of Liquid-Liquid Extraction and Resin Adsorption for Concentrating Mutagens in Ames Salmonella/Microsome Assays on Water, W82-01812 5A

NATIONAL INST. OF RADIOLOGICAL SCIENCES, CHIBA (JAPAN). DIV. OF ENVIRONMENTAL HEALTH.
Measurement of Heavy Water Concentration with a Density Meter, W82-02009 5A

NATIONAL MARINE FISHERIES SERVICE, BEAUFORT, NC. SOUTHEAST FISHERIES CENTER.
Gulf of Mexico Wetlands: Value, State of Knowledge and Research Needs, W82-01902 2L

NATIONAL OCEAN SURVEY, ROCKVILLE, MD. OCEAN DUMPING AND MONITORING DIV.
Industrial Waste Dumping at Deepwater Sites in the Gulf of Mexico, W82-01903 5E

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, ANN ARBOR, MI. GREAT LAKES ENVIRONMENTAL RESEARCH LAB.
A Method of Objective Analysis for Currents in a Lake with Application to Lake Ontario, W82-01616 2H

Effect of the Algal Length/Aperture Length Ratio on Coulter Analyses of Lake Seston, W82-01823 7B

Abiotic Versus Biotic Uptake of Radiophosphorus in Lake Water, W82-01824 2H

Variance Estimates for a Dynamic Eutrophication Model of Saginaw Bay, Lake Huron, W82-01917 2H

Quantification of the Lake Trophic Typologies of Naumann (Surface Quality) and Thienemann (Oxygen) with Special Reference to the Great Lakes, W82-02004 2H

NATIONAL RESEARCH INST. FOR OCEANOGRAPHY, STELLENBOSCH (SOUTH AFRICA).
Variations in Trace Metal Content of the Mussel Choromytilus Meridionalis (Kr.) with Season and Sex, W82-01969 5A

NATIONAL WATER COUNCIL, LONDON (ENGLAND).
Charging for Water Supply in England and Wales in the 1980s, W82-01722 6C

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO).
Loading Estimates to Lake Erie, 1967-1976, W82-01852 5A

NATIONAL WATER RESEARCH INST., BURLINGTON (ONTARIO). WATER QUALITY BRANCH.
Interlaboratory Quality Control Study No. 26, Arsenic and Selenium in Water, W82-01854 5A

NATIONAL WATER RESEARCH INST., BURLINGTON, (ONTARIO). WATER RESOURCES BRANCH.
Glacier Surveys in Alberta - 1979, W82-01855 2C

NATIONAL WATER RESEARCH INST., VANCOUVER (BRITISH COLUMBIA). PACIFIC AND YUKON REGION.
Variations and Mechanisms of Asbestos Fibre Distribution in Stream Water, W82-01853 5A

NEBRASKA UNIV., LINCOLN.
The National Water Policy Review and Western Water Rights Law Reform: An Overview, W82-01659 6E

NEBRASKA UNIV., LINCOLN. SCHOOL OF LIFE SCIENCES.
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Eutrophication of the Salt Valley Reservoirs 1968-73. III. The Macroinvertebrate Community: Its Development, Composition, and Change in Response to Eutrophication, W82-01797 5C

NEW HAMPSHIRE UNIV., DURHAM. DEPT. OF CHEMISTRY.
Copper(II)- and Cadmium(II)-Binding Abilities of Some New Hampshire Freshwaters Determined by Dialysis Titration, W82-01632 5F

NEW UNIV. OF ULSTER, COLERAINE (NORTHERN IRELAND). SCHOOL OF BIOLOGICAL AND ENVIRONMENTAL STUDIES.
Effect of the Copper Content of Distillery Spent Wash on Its Utilization for Single-Cell Protein Production by Geotrichum Candidum, Hansenula Anomala and Candida Kruzei, W82-01750 5C

NEW YORK STATE DEPT. OF PUBLIC SERVICE, ALBANY. OFFICE OF ENVIRONMENTAL PLANNING.
Occult Hemoglobin as an Indicator of Impingement Stress in Fishes, W82-01931 5C

NEWCASTLE UPON TYNE UNIV. (ENGLAND). DEPT. OF ECONOMICS.
Economic Instruments for Controlling Effluent Discharges to the River Tees Estuary, W82-02060 2L

NORGES LANDBRUKSHOEGSKOLE, VOLLEBEKK.
Discharge Measurements by a New-Formed Relative Salt-Dilution Method in Small Turbulent Streams, W82-01891 7B

Groundwater Chemistry of Some Selected Areas in Southeaster Norway, W82-02020 2K

NORGES LANDBRUKSHOEGSKOLE, VOLLEBEKK. DEPT. OF GEOLOGY.
Groundwater Discharge Through Springs with Well-Defined Outlets--A Case Study from Jeloya-Moss, S. Norway, W82-01748 2F

NORTH CAROLINA STATE UNIV. AT RALEIGH. DEPT. OF MARINE EARTH, AND ATMOSPHERIC SCIENCES.
A Graphical Approach to Prediction of Groundwater Pollutant Movement, W82-01634 5B

Perspective on Management and Disposal of Hazardous Wastes, W82-01635 5E

NORTH CAROLINA STATE UNIV. AT RALEIGH. PESTICIDE RESIDUE RESEARCH LAB.
Investigation of Selective Uptake of Polychlorinated Biphenyls by Spartina Alterniflora Loisel, W82-01813 5B

NORTHERN IRELAND DEPARTMENT OF AGRICULTURE, COLERAINE, FISHERIES RESEARCH LABORATORY.
Effects of Pollution Upon the Benthos of Belfast Lough, W82-02059 5C

OAK RIDGE NATIONAL LAB., TN. ENVIRONMENTAL SCIENCES DIV.
The Natural Acidity of Some Unpolluted Waters in Southeastern Alaska and Potential Impacts of Acid Rain, W82-01867 5B

Chromium Levels in Fish from a Lake Chronically Contaminated with Chromates from Cooling Towers, W82-01941 5B

OKLAHOMA STATE UNIV., STILLWATER.
Predicting Storm Runoff from Small Grassland Watersheds with the USDAHL Hydrologic Model,
W82-01672 2E

OKLAHOMA STATE UNIV., STILLWATER. DEPT. OF AGRONOMY.
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W82-01862 2I

OLD DOMINION UNIV. NORFOLK, VA.
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W82-01674 2L

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W82-01661 5A

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W82-02091 5F

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W82-01907 5D

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W82-01828 5A

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The Relationship Between Macro-Topography and the Groundwater Quality in the Great Fish River Basin, Eastern Cape Province,
W82-01718 2F

ORANGE FREE STATE UNIV., BLOEMFONTEIN (SOUTH AFRICA). DEPT. OF MICROBIOLOGY.
Composition of Fruit and Vegetable Processing Wastes,
W82-01601 5D

OREGON GRADUATE CENTER, BEAVERTON.
Kinetics for the Aquatic Environment,
W82-01631 2K

Kinetics for the Aquatic Environment,
W82-01806 2K

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W82-01681 5A

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W82-01879 2F

OTAGO UNIV., DUNEDIN (NEW ZEALAND). DEPT. OF ZOOLOGY.
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W82-01700 2H

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W82-02032 2B

PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. DEPT. OF CIVIL ENGINEERING.
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W82-01664 2E

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Centrifugal Dewatering,
W82-01912 5E

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W82-02051 5C

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W82-01836 5A

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A Comprehensive Methodology for Project Appraisal and Environmental Protection in Multinational River Basin Development,
W82-01914 6B

PRINCETON UNIV., NJ. DEPT. OF CIVIL ENGINEERING.
Hydraulic Modeling for Waste Stabilization Ponds,
W82-01965 5D

PURDUE UNIV., LAFAYETTE, IN. DEPT. OF AGRICULTURAL ENGINEERING.
Estimating Erosion and Sediment Yield on Field-Sized Areas,
W82-01849 2J

PURDUE UNIV., LAFAYETTE, IN. SCHOOL OF CIVIL ENGINEERING.
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W82-01651 2B

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W82-01938 2L

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W82-02047 5D

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Generalized Computer Simulation Model for the Impact Assessment of Industrial Water Use on Fish Populations,
W82-01915 5C

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W82-02070 2H

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W82-01736 2J

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W82-02029 5A

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W82-02057 2L

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Tide-Induced Residual Flow in Shallow Bays,
W82-02003 2L

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W82-01695 5A

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W82-01648 5G

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W82-01611 2G

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W82-01771 7B

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W82-02013 5B

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W82-01769 5G

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W82-01770 2J

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W82-01976 3F

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W82-02023 2H

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W82-01892 2B

SEVERN TRENT WATER AUTHORITY, BIRMINGHAM (ENGLAND).
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W82-02035 5G

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W82-01960 5B

SNOWY MOUNTAINS ENGINEERING CORP., COOMA (AUSTRALIA).
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W82-01857 2A

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W82-01636 5E

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W82-02046 2F

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W82-01730 4D

Resource Inventory--Sheet, Rill and Wind Erosion,
W82-01850 2J

SONNEN (M. B.) CO., INC., WALNUT CREEK, CA.
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W82-01667 3F

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W82-01875 2L

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W82-01656 5A

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W82-01742 6A

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W82-01610 4C

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W82-01694 6A

Effect of Reagent Mixing Rate on Adsorption Process for Am-Fe2O3.H2O,
W82-01799 5F

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W82-01684 1A

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W82-02006 5D

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W82-01869 5B

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W82-01618 5D

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W82-02026 5D

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W82-02030 2H

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W82-01825 5C

TERRAQUA APS, KALUNDBORG (DENMARK).
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W82-01890 2F

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W82-01859 3F

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W82-02014 5G

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W82-02040 6E

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W82-02039 5D

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Irrigation for Brazil's Poligono Das Secas,
W82-01744 3F

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W82-01987 5B

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W82-02007 5A

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W82-01876 5D

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W82-02012 5A

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W82-02050 5D

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W82-01881 5C

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W82-01930 2L

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W82-01723 2I

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W82-01746 2L

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W82-01671 3F

Watershed Constituent Loading Analysis Utilizing Empirical Hydro-Chemical Modeling Techniques,
W82-01676 5B

Random Differential Equations in Water Quality Modeling,
W82-01688 6A

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W82-02015 5D

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Furrow Advance Rates Under Surge Flow Systems,
W82-01612 3F

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W82-01633 2D

Simplified Method for Rainfall Intensities,
W82-01978 2B

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W82-01945 3F

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W82-01692 5D

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W82-01863 5D

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W82-01689 5A

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VISVA-BHARATI UNIV., SANTINIKETAN (INDIA). DEPT. OF ZOOLOGY.
Detection of Organophosphate Insecticide by an Immobilized-Enzyme System,
W82-02025 5A

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL).
Turnover of Tritiated Water in Calamondin Plants,
W82-02048 5A

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN (ISRAEL). DEPT. OF SOIL PHYSICS.
Effect of Field Variability in Soil Hydraulic Properties on Solutions of Unsaturated Water and Salt Flows,
W82-01898 2G

VOLCANI INST. OF AGRICULTURAL RESEARCH, BET-DAGAN ISRAEL). DIV. OF SUBTROPICAL HORTICULTURE.
Shortening the Irrigation Interval as a Means of Saving Water in a Banana Plantation,
W82-02093 3F

WAIKATO UNIV., HAMILTON (NEW ZEALAND). DEPT. OF EARTH SCIENCES.
Note on Two Limit Distributions of Bedload Movement,
W82-01643 2J

WAIKATO UNIV., HAMILTON (NEW ZEALAND). SCHOOL OF SCIENCE.
Limnology of Lake Rerewhakaaitu,
W82-01705 2H

WASHINGTON STATE UNIV., PULLMAN. DEPT. OF AGRONOMY AND SOILS.
Simulation of Water and Nitrogen Movement and Nitrogen Transformations in Forest Soils,
W82-01668 2G

WASHINGTON UNIV., SEATTLE. DEPT. OF ATMOSPHERIC SCIENCES.
Towards an Understanding of the Effects of Orography on the Distribution of Precipitation Over the Cape Peninsula,
W82-02085 2B

WATERLOO UNIV. (ONTARIO). DEPT. OF GEOGRAPHY.
Regulation for Environmental Protection: The Nanticoke Industrial Complex, Ontario, Canada,
W82-02024 6E

WESTERN AUSTRALIA UNIV., NEDLANDS. DEPT. OF SOIL SCIENCE AND PLANT NUTRITION.
The Influence of Tillage on Soil Water Behavior,
W82-02022 2G

WESTERN MICHIGAN UNIV., KALAMAZOO.
A Limnological Investigation of a Tropical Fresh-Water Ecosystem: The Belize River, Belize, Central America,
W82-01682 5G

WINDSOR UNIV. (ONTARIO). DEPT. OF BIOLOGY.
Zooplankton Species Diversity in Lake St. Clair, Ontario, Canada,
W82-01937 5C

WISCONSIN UNIV.-MADISON.
Regulating the Quality of Drinking Water: An Economic Analysis of the Safe Drinking Water Act of 1974,
W82-01691 5G

Pollution Permits and Markets for Water Quality,
W82-01699 6A

WISCONSIN UNIV.-MILWAUKEE. CENTER FOR GREAT LAKES STUDIES.
Effects of Thermocline Displacement Upon Subsurface Chlorophyll Maxima in Lake Michigan,
W82-01957 2H

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF CIVIL ENGINEERING.
Water Reuse: Ultrafiltration of Industrial and Municipal Wastewaters,
W82-01652 5D

WISCONSIN UNIV.-MILWAUKEE. DEPT. OF GEOLOGICAL SCIENCES.
Hydraulic Connection Between Lake Michigan and a Shallow Ground-Water Aquifer,
W82-02010 2F

WRIGHT WATER ENGINEERS, INC., DENVER, CO.
Food and Energy Production: Conjunctive Water Planning,
W82-01856 3C

WYOMING UNIV., LARAMIE. DEPT. OF ATMOSPHERIC SCIENCE.
Photometric Investigations of Precipitable Water and Optical Depth Wavelength Exponents in an Urban Area,
W82-01966 2B

WYOMING UNIV., LARAMIE. DEPT. OF ZOOLOGY AND PHYSIOLOGY.
Periphytic Community Response to Chronic Nutrient Enrichment by a Reservoir Discharge,
W82-01658 5C

YORK UNIVERSITY, HESLINGTON (ENGLAND). INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH.
Standards and Charges in the Control of Trade Effluent Discharges to Public Sewers in England and Wales,
W82-01717 6C

YORK WATER CO., PA.
Perseverance Produces County Park,
W82-01932 6D

YORKSHIRE WATER AUTHORITY (ENGLAND).
Recording Underground,
W82-02036 8A

ZURICH SERVICE DES EAUX (SWITZERLAND).
Water Pollution: A Risk to the Future in the Case of the Rhine (Eaux Polluees' Avenir en Danger Dans le Cas du Rhin),
W82-02067 5G

ACCESSION NUMBER INDEX

W82-01601 5D
W82-01602 7B
W82-01603 6E
W82-01604 4D
W82-01605 2G
W82-01606 5A
W82-01607 5C
W82-01608 5G
W82-01609 2A
W82-01610 4C
W82-01611 2G
W82-01612 3F
W82-01613 8G
W82-01614 5B
W82-01615 2L
W82-01616 2H
W82-01617 2A
W82-01618 5D
W82-01619 5A
W82-01620 5A
W82-01621 5A
W82-01622 5D
W82-01623 5C
W82-01624 5D
W82-01625 5B
W82-01626 5D
W82-01627 5D
W82-01628 5D
W82-01629 5C
W82-01630 5E
W82-01631 2K
W82-01632 5F
W82-01633 2D
W82-01634 5B
W82-01635 5E
W82-01636 5E
W82-01637 5A
W82-01638 2H
W82-01639 5B
W82-01640 5C
W82-01641 5C
W82-01642 6B
W82-01643 2J
W82-01644 2J
W82-01645 5C
W82-01646 7A
W82-01647 2F
W82-01648 5G
W82-01649 2E
W82-01650 2E
W82-01651 2B
W82-01652 5D
W82-01653 5C
W82-01654 5B
W82-01655 6B
W82-01656 5A
W82-01657 2A
W82-01658 5C
W82-01659 6E
W82-01660 5E
W82-01661 5A
W82-01662 5B
W82-01663 5C
W82-01664 2E
W82-01665 6F
W82-01666 2G
W82-01667 3F
W82-01668 2G
W82-01669 6B
W82-01670 1A
W82-01671 3F
W82-01672 2E
W82-01673 2F
W82-01674 2L
W82-01675 6A
W82-01676 5B
W82-01677 6A
W82-01678 5B
W82-01679 5C
W82-01680 6A
W82-01681 5A
W82-01682 5G
W82-01683 5G
W82-01684 1A
W82-01685 6A
W82-01686 2A
W82-01687 5G
W82-01688 6A
W82-01689 5A
W82-01690 2C
W82-01691 5G
W82-01692 5D
W82-01693 2F
W82-01694 6A
W82-01695 5A
W82-01696 3A
W82-01697 5F
W82-01698 6B
W82-01699 6A
W82-01700 2H
W82-01701 5C
W82-01702 2H
W82-01703 4C
W82-01704 5C
W82-01705 2H
W82-01706 2H
W82-01707 2E
W82-01708 2G
W82-01709 4C
W82-01710 2F
W82-01711 4A
W82-01712 5A
W82-01713 2I
W82-01714 2J
W82-01715 5B
W82-01716 5B
W82-01717 6C
W82-01718 2F
W82-01719 7B
W82-01720 2L
W82-01721 2G
W82-01722 6C
W82-01723 2I
W82-01724 8A
W82-01725 6B
W82-01726 8A
W82-01727 5D
W82-01728 5F
W82-01729 4D
W82-01730 4D
W82-01731 2E
W82-01732 2B
W82-01733 5D
W82-01734 6C
W82-01735 2C
W82-01736 2J
W82-01737 5A
W82-01738 6D
W82-01739 4A
W82-01740 6G
W82-01741 4B
W82-01742 6A
W82-01743 4A
W82-01744 3F
W82-01745 2I
W82-01746 2L
W82-01747 8A
W82-01748 2F
W82-01749 2L
W82-01750 5C
W82-01751 6D
W82-01752 6D
W82-01753 6D
W82-01754 6D
W82-01755 6D
W82-01756 6D
W82-01757 6D
W82-01758 6D
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W82-01760 6D
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W82-01762 6D
W82-01763 6D
W82-01764 6D
W82-01765 6D
W82-01766 6D
W82-01767 6D
W82-01768 6G
W82-01769 5G
W82-01770 2J
W82-01771 7B
W82-01772 2A
W82-01773 6B
W82-01774 7C
W82-01775 7C
W82-01776 2J
W82-01777 7C
W82-01778 10C
W82-01779 2E
W82-01780 6A
W82-01781 2E
W82-01782 2F
W82-01783 5A
W82-01784 5A
W82-01785 2F
W82-01786 5C
W82-01787 7C
W82-01788 7C
W82-01789 3A
W82-01790 5B
W82-01791 7C
W82-01792 7C
W82-01793 4A
W82-01794 5C
W82-01795 2K
W82-01796 4A
W82-01797 5C
W82-01798 5B
W82-01799 5F
W82-01800 5D
W82-01801 5B
W82-01802 5B
W82-01803 9A
W82-01804 6E
W82-01805 2L
W82-01806 2K
W82-01807 6A
W82-01808 5B
W82-01809 5B
W82-01810 5B
W82-01811 5C
W82-01812 5A
W82-01813 5B
W82-01814 5B
W82-01815 5A
W82-01816 5B
W82-01817 5B
W82-01818 5C
W82-01819 5A
W82-01820 5B
W82-01821 5A
W82-01822 5C
W82-01823 7B
W82-01824 2H
W82-01825 5C
W82-01826 7B
W82-01827 2D
W82-01828 5A
W82-01829 5B
W82-01830 5C
W82-01831 2H
W82-01832 2H
W82-01833 5F
W82-01834 2G
W82-01835 5A
W82-01836 5A
W82-01837 2H
W82-01838 2H
W82-01839 2H
W82-01840 2H
W82-01841 2H
W82-01842 2J
W82-01843 2C
W82-01844 5A
W82-01845 5B
W82-01846 2I
W82-01847 6E
W82-01848 6A
W82-01849 2J
W82-01850 2J
W82-01851 6E
W82-01852 5A
W82-01853 5A
W82-01854 5A
W82-01855 2C
W82-01856 3C
W82-01857 2A
W82-01858 2E
W82-01859 3F
W82-01860 3F
W82-01861 2G
W82-01862 2I
W82-01863 5D
W82-01864 6A
W82-01865 5D
W82-01866 5G
W82-01867 5B
W82-01868 5B
W82-01869 5B
W82-01870 6E
W82-01871 6E
W82-01872 6F
W82-01873 5B
W82-01874 5F
W82-01875 2L
W82-01876 5D
W82-01877 5B
W82-01878 3F
W82-01879 2F
W82-01880 2G
W82-01881 5C
W82-01882 5C
W82-01883 2I
W82-01884 6A
W82-01885 2C
W82-01886 2G
W82-01887 2C
W82-01888 2D
W82-01889 2C
W82-01890 2F
W82-01891 7B
W82-01892 2B
W82-01893 2J
W82-01894 7B
W82-01895 5D
W82-01896 5D
W82-01897 2G
W82-01898 2G
W82-01899 5D
W82-01900 5D
W82-01901 6B
W82-01902 2L
W82-01903 5E
W82-01904 2F
W82-01905 5A
W82-01906 3C
W82-01907 5D
W82-01908 6G
W82-01909 6A
W82-01910 7B
W82-01911 5A
W82-01912 5E
W82-01913 5G
W82-01914 6B
W82-01915 5C
W82-01916 3F
W82-01917 2H
W82-01918 2J
W82-01919 5C
W82-01920 5C
W82-01921 2H
W82-01922 5C
W82-01923 2H
W82-01924 2H
W82-01925 5B
W82-01926 2F
W82-01927 2F
W82-01928 5B
W82-01929 5D
W82-01930 2L
W82-01931 5C
W82-01932 6D
W82-01933 5B
W82-01934 4D
W82-01935 2H
W82-01936 2K

W82-01937 5C
W82-01938 2L
W82-01939 7B
W82-01940 6E
W82-01941 5B
W82-01942 6D
W82-01943 3C
W82-01944 3F
W82-01945 3F
W82-01946 2H
W82-01947 7B
W82-01948 4A
W82-01949 5C
W82-01950 7B
W82-01951 8E
W82-01952 8D
W82-01953 8D
W82-01954 8D
W82-01955 1B
W82-01956 1B
W82-01957 2H
W82-01958 2J
W82-01959 2H
W82-01960 5B
W82-01961 5B
W82-01962 5B
W82-01963 2J
W82-01964 5D
W82-01965 5D
W82-01966 2B
W82-01967 2B
W82-01968 2B
W82-01969 5A
W82-01970 5C
W82-01971 5C
W82-01972 5B
W82-01973 8A
W82-01974 5D
W82-01975 2B
W82-01976 3F
W82-01977 3F
W82-01978 2B
W82-01979 8C
W82-01980 2A
W82-01981 2E
W82-01982 2F
W82-01983 2F
W82-01984 2F
W82-01985 5C
W82-01986 2F
W82-01987 5B
W82-01988 7B
W82-01989 5B
W82-01990 6E
W82-01991 5G
W82-01992 5D
W82-01993 5C
W82-01994 5G
W82-01995 7B
W82-01996 5C
W82-01997 2H
W82-01998 5C
W82-01999 2H
W82-02000 4A
W82-02001 3F
W82-02002 2J
W82-02003 2L
W82-02004 2H
W82-02005 5B
W82-02006 5D
W82-02007 5A
W82-02008 5A
W82-02009 5A
W82-02010 2F
W82-02011 5E
W82-02012 5A
W82-02013 5B
W82-02014 5G
W82-02015 5D
W82-02016 5A
W82-02017 2F
W82-02018 5B
W82-02019 3F
W82-02020 2K
W82-02021 6G
W82-02022 2G
W82-02023 2H
W82-02024 6E
W82-02025 5A
W82-02026 5D
W82-02027 2H
W82-02028 5B
W82-02029 5A
W82-02030 2H
W82-02031 3F
W82-02032 2B
W82-02033 5C
W82-02034 2G
W82-02035 5G
W82-02036 8A
W82-02037 6A
W82-02038 2L
W82-02039 5D
W82-02040 6E
W82-02041 5D
W82-02042 2I
W82-02043 5D
W82-02044 5D
W82-02045 2I
W82-02046 2F
W82-02047 5D
W82-02048 5A
W82-02049 5D
W82-02050 5D
W82-02051 5C
W82-02052 2H
W82-02053 5C
W82-02054 2H
W82-02055 2H
W82-02056 5B
W82-02057 2L
W82-02058 5B
W82-02059 5C
W82-02060 2L
W82-02061 6C
W82-02062 6G
W82-02063 2E
W82-02064 2E
W82-02065 2K
W82-02066 6E
W82-02067 5G
W82-02068 8A
W82-02069 5A
W82-02070 2H
W82-02071 5B
W82-02072 2H
W82-02073 5B
W82-02074 7A
W82-02075 5A
W82-02076 5B
W82-02077 2H
W82-02078 2H
W82-02079 2H
W82-02080 2H
W82-02081 2H
W82-02082 2H
W82-02083 5C
W82-02084 5B
W82-02085 2B
W82-02086 7A
W82-02087 6E
W82-02088 6D
W82-02089 6B
W82-02090 5C
W82-02091 5F
W82-02092 5G
W82-02093 3F
W82-02094 2D
W82-02095 5C
W82-02096 7B
W82-02097 5B
W82-02098 5B
W82-02099 2F
W82-02100 2H

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Subject Fields

1 NATURE OF WATER

2 WATER CYCLE

3 WATER SUPPLY AUGMENTATION AND CONSERVATION

4 WATER QUANTITY MANAGEMENT AND CONTROL

5 WATER QUALITY MANAGEMENT AND PROTECTION

6 WATER RESOURCES PLANNING

7 RESOURCES DATA

8 ENGINEERING WORKS

9 MANPOWER, GRANTS, AND FACILITIES

10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSSION NUMBER INDEX

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